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ABSTRACT

This curriculum guide contains four units with relevant problem areas and is intended as a source unit for agricultural education. These problem areas have been selected as suggested areas of study to be included in a core curriculum for secondary students enrolled in an agricultural education program. Each problem area includes some or all of the following components: related problem areas, prerequisite problem areas, occupational tasks addressed, learning assessment plan sheets, instructor's guide, information sheets, student worksheets or assignment sheets and keys, demonstrations, transparency masters, and a discussion guide for transparencies. Suggestions are made for use of the core materials, including specific suggestions for using the different components of a problem area. The guide contains four units: (1) environmental protection; (2) forestry; (3) fish and wildlife management; and (4) outdoor recreation. (NLA)

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CORE

Agricultural Education Curriculum

Central Cluster
Agricultural Business and Management Cluster
Horticulture Cluster
■ Agricultural Resources Cluster

Illinois State Board of Education

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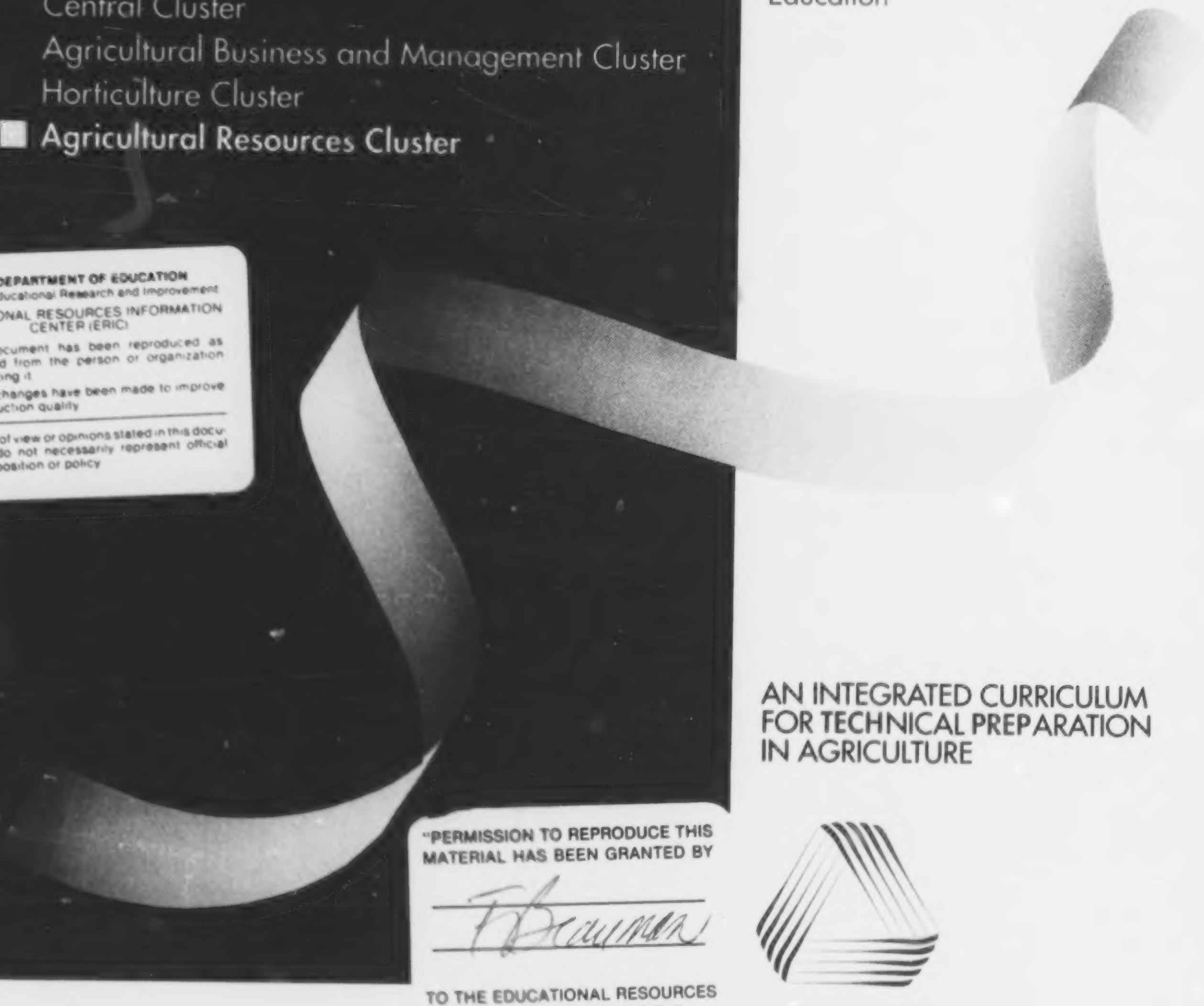

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AN INTEGRATED CURRICULUM FOR TECHNICAL PREPARATION IN AGRICULTURE

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Program Improvement Section

1990

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Acknowledgments

Appreciation is expressed to the many agricultural educators who shared their time, knowledge, and instructional aids for the preparation of this core curriculum. Without their cooperation and input, this printing would not have been possible.

Suggestions for Using Core Materials

It is recommended that teachers planning to use the attached curriculum guides and teaching aids refer to the **Illinois Plan for Agricultural Education: Secondary Core Curriculum Implementation Guide** for specific guidelines. This booklet includes ideas, suggestions and a step-by-step set of instructions for revising local programs and courses. These curriculum guides and teaching aids have been designed to improve instruction in agri-science and business management and to enhance student learning in these areas. Each problem area includes some or all of the following components:

1. Related problem areas
2. Prerequisite problem areas
3. Occupational tasks addressed
4. Learning assessment plan sheets
5. Instructor's guide
6. Information sheets
7. Student worksheets or assignment sheets and keys
8. Demonstrations
9. Transparencies
10. Discussion guide for transparencies

This curriculum guide should be utilized as a source unit. This means that teachers should selectively choose those components which they need to achieve their teaching objectives. The project staff does not recommend that teachers "teach" the core program as it is presented. Instead, the teacher should personalize and localize the materials for the particular group taught and, wherever possible, add other materials and teaching techniques to enrich the core program.

Teachers could teach everything included in the core curriculum but this would not be advisable considering the variations which exist in agriculture programs, students' needs and interests, and program objectives. Instead, teachers should select problem areas for a "local core" and supplement them with other problem areas important in the local area. Another suggestion is that an entire unit need not be taught to a given group during a given year. For example, teachers may want to teach part of the Food Science and Technology Unit to freshmen and teach the remaining part to an advanced class.

Specific suggestions for using the different components of a problem area are presented in the following section.

1. **Related problem areas.** These problem areas are included to assist teachers in planning their programs and course outlines. Teachers should review these problem areas when scheduling their courses to get an overview of the subject matter included in the core which is related to selected agricultural topics.
2. **Prerequisite problem areas.** Many of the core problem areas may require a current knowledge of science, mathematics, communications, or basic agricultural concepts. This section will alert the teacher if this problem area requires any previous or specific instruction.
3. **Occupational tasks addressed.** Instructors in Education for Employment programs have identified the occupational tasks which are to be taught in their courses. This section identifies those tasks from the state developed task lists which can be addressed within the context of this problem area.
4. **Learning assessment plan sheets.** The recently amended School Code of Illinois requires that goals for learning be identified and taught. This section identifies those State Goals for Learning and Learning Objectives which can be addressed within the context of this problem area.
5. **Instructor's guide.** The instructor's guide is not a lesson plan. It is a source of teaching ideas which may be implemented by the agriculture teacher to conduct an effective instructional program. Each guide includes more material than most teachers would use. Teachers should select from the several interest approaches and teaching activities those suggestions which seem most appropriate for the local situation. The instructor's guide emphasizes a problem-solving method and a student-centered, activity approach. Lecture-presentation and rote memorization of facts should be kept to a minimum. The instructor's guides include suggestions for carrying learning to the "doing" level. Application of classroom learning to SAEPs and FFA activities is an important part of the teaching process.
6. **Information sheets.** These sheets have been prepared for those problem areas where technical information on the subject may be difficult to locate. If reference materials are not available, the teacher may want to duplicate copies of the information sheets for class use.

7. **Student worksheets or assignment sheets and keys.** These exercises are designed as classroom activities for student use. They may provide a change of pace for students when introducing, reinforcing or mastering certain agricultural concepts. Most exercises include a teacher's key with suggested answers.
8. **Demonstrations.** The teaching of certain problem areas often calls for demonstrations of manipulative skills or scientific principles. The demonstration outline may be used by the teacher or students to conduct demonstrations of science principles and manipulative skills. Teachers may want to change some of the student activities included in the instructor's guide into student demonstrations.
9. **Transparencies.** Some of the problem areas include transparency masters which can be used to prepare transparencies for the teachers to use when discussing certain concepts and subject matter.
10. **Discussion guide for transparencies.** Most of the transparencies included in the core materials do not include on the overlay any narration or explanation. The discussion guide provides teachers with some suggested points to bring out in the discussion of a transparency including explanations, descriptions, and discussion questions related to the transparency. The information sheets may also provide pertinent information useful in the discussions associated with the transparencies.

The core materials, if used properly, can improve the teaching process and save valuable teacher time. At the same time, misuse or overuse of these materials may lead to a lock-step approach to teaching and learning with the teacher adding little in the way of resourceful innovations and creative techniques. **The Illinois Plan for Agricultural Education: A Planning Guide** stresses the need to broaden local curricula in order to meet the needs of several audiences. It emphasizes the need to address several objectives at each level of a comprehensive program. It is recommended that this booklet be reviewed as you are evaluating your local program needs.

For best results when using the Core Curriculum materials, teachers should:

1. Use the curriculum but don't handle it like a teaching plan.
2. Localize the curriculum for their community.
3. Personalize the curriculum for their students.
4. Supplement the curriculum to achieve local objectives.

Illinois State Board of Education

Department of Adult, Vocational and Technical Education
Program Improvement Section
Product Abstract

1. Title of material: Agricultural Resources Materials for Agricultural Education Programs
2 Date material was completed: June, 1990
3. Please check one: New material ____ Revised X
4. Originating agency: University of Illinois
   Address: Urbana, Illinois Zip Code: 61801
5. Name of developer: Dale A. Law
   Address: 1301 West Gregory, Urbana, IL Zip Code: 61801
6. Developed pursuant to Contract Number: PLAC20 D

---

7. Subject Matter (Check only one according to USOE Code):
   USOE Code
   - X 01 Agricultural Education
   - ____ 03 Business and Office Education
   - ____ 04 Distributive Education
   - ____ 07 Health Occupations Education
   - ____ 09 Home Economics Education
   - ____ 10 Industrial Art Education
   - ____ 16 Technical Education
   - ____ 17 Trade and Industrial Education
   - ____ Career Education
   - Other (Specify)

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8. Education Level:
   - ____ Pre-K Thru 6
   - X Post-Secondary
   - ____ Administrator (Pre-Service)
   - ____ 7-8
   - ____ Adult
   - X 9-10
   - ____ Teacher (Pre-service)
   - ____ Other (Specify) ____
   - X 11-12

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9. Intended for Use By:
   - X Student
   - ____ Teacher Educator
   - ____ Other (Specify) ____
   - X Classroom Teacher
   - ____ Guidance Staff
   - ____ Local Administrator
   - ____ State Personnel

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10. Student Type:
    - X Regular
    - ____ Limited English Proficiency
    - X Disadvantaged
    - ____ Other (Specify) ____
    - X Handicapped

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11. Medium and Format of Materials:
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      - ____ inches
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      - ____ Minutes
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      - ____ B & W
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Contact:
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Springfield, IL 62777
(217) 782-4620

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16. General Description:

This curriculum guide includes teaching units for the Agricultural Resources Cluster problem areas selected as suggested areas of study to be included in a core curriculum for secondary students enrolled in an agricultural education program.

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17. Person Completing this Abstract: Dale A. Law

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ILLINOIS AGRICULTURAL CORE CURRICULUM REVISION
UNITS AND PROBLEM AREAS

Agricultural Resources Cluster

Unit A: Environmental Protection

1. Conserving Water Resources
2. Controlling Air Pollution
3. Understanding Government Regulations and Controls
4. Managing Land Resources
5. Managing Freshwater Resources

Unit B: Forestry

1. Classifying Trees
2. Identifying Trees and Forestry Products
3. Managing Forestry Resources
4. Producing Christmas Trees
5. Processing Forestry Products

Unit C: Fish and Wildlife Management

1. Classifying Fish
2. Stocking Fish
3. Feeding Fish
4. Managing Fish
5. Classifying Game Birds and Animals
6. Feeding Game Birds and Animals
7. Controlling Wildlife Pests
8. Raising Game Birds and Animals
9. Maintaining Wildlife Habitat

Unit D: Outdoor Recreation

1. Managing Game Preserves
2. Managing Hunting and Fishing Clubs
3. Practicing Hunting Safety
4. Identifying Outdoor Recreational Enterprises
5. Adhering to Laws and Regulations
6. Managing Golf Courses
7. Managing Parks and Recreational Areas

UNIT A: Environmental Protection

PROBLEM AREAS:

1. Conserving Water Resources
2. Controlling Air Pollution
3. Understanding Government Regulations and Controls
4. Managing Land Resources
5. Managing Freshwater Resources

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Environmental Protection

PROBLEM AREA: Conserving Water Resources

RELATED PROBLEM AREAS:

1. Controlling Air Pollution
2. Managing Land Resources
3. Managing Freshwater Resources
4. Managing Forestry Resources
5. Understanding Government Regulations and Controls
6. Understanding the Relationship Between Agriculture and the Environment (Central Core Cluster)
7. Conserving Agricultural Resources (Central Core Cluster)

PREREQUISITE PROBLEM AREA(S): None

LEVEL: Orientation

OCCUPATIONAL TASKS ADDRESSED:

Agricultural Resources Cluster

Duty A: Managing the Recreational Facility

1. Determine land-use capability

Duty B: Applying Laws, Regulations, and Policies

1. Interpret stream, lake, pond, and groundwater laws
2. Interpret Environmental Protection Agency (EPA) regulations

Duty G: Assembling, Servicing, and Maintaining Equipment and Facilities

1. Maintain grounds and recreation areas
2. Maintain facilities drainage ditches
3. Inspect water and sewer systems

STATE GOALS FOR LEARNING

In planning the instruction for this problem area, teachers can promote the development of several student learning objectives which are related to the State Goals for Learning in Biological and Physical Sciences and Social Sciences. These objectives are listed on the Learning Assessment Plan forms included on the following page(s). Those learning objectives marked with an asterisk (*) are taken from the sample lists provided by the Illinois State Board of Education.

CORE

Illinois Agricultural Core Curriculum

Agricultural Education 124 Mumford Hall 1301 W. Gregory Drive University of Illinois Urbana, IL 61801

Director: Dale A. Law, Ed.D.
Principal Investigator: Jerry D. Pepple, Ed.D
Research Assistant: Kevin J. Enderlin

Illinois Agricultural Core Curriculum Rev.

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

Submission Date ______
☐ Original submission ☐ Revision
Page ____ of ____

I. LEARNING AREA *(check one)*
☐ Language Arts ☐ Fine Arts
☐ Mathematics ☒ Social Sciences
☐ Sciences ☐ Physical Development/Health

(Affix label or complete district information.)
COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐
District Name
City

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will be able to demonstrate a knowledge of world geography with emphasis on the United States.

Contact Person: ______
Title: ______
Phone: ( )

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade (circle one) 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Understand how decisions affecting the use of the natural environment can have both positive and negative results.					
2. List major sources of groundwater contamination.					
3. Identify the impacts of acid precipitation.					

Agricultural Resources
Environmental Protection

ISBE 41-78 (1/88)

Conserving Water Resources

Conserving Water Resources

Illinois Agricultural Core Curriculum Rev.

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LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

Submission Date ____________

☐ Original submission ☐ Revision

Page ____ of ____

I. LEARNING AREA *(check one)*

☐ Language Arts ☐ Fine Arts
☐ Mathematics ☒ Social Sciences
☐ Sciences ☐ Physical Development/Health

(Affix label or complete district information.)

COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐

District Name

City

Contact Person: ____________

Title: ____________

Phone: (   )

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will be able to apply the skills and knowledge gained in the social sciences to decision making in life situations.

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Understanding the knowledge and skills required for success in selected fields of work.					
*2. Recognize that competence in a field of work entails the development of a wide range of skills.					
3. Describe the route of agricultural pesticides to groundwater.					
4. Identify the sources of rural well water pollution.					
5. Identify the sources of the Illinois water supply.					

Agricultural Resources
Environmental Protection

4

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Department of School Improvement Services
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LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

Submission Date____________________
☐ **Original submission** ☐ **Revision**
Page ____ of ____

I. LEARNING AREA *(check one)*
☐ Language Arts
☐ Mathematics
☒ Sciences
☐ Fine Arts
☐ Social Sciences
☐ Physical Development/Health

(Affix label or complete district information.)
COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐
District Name
City

II. STATE GOAL FOR LEARNING
As a result of their schooling, students will have a working knowledge of the concepts and basic vocabulary of biological, physical, and environmental sciences and their application in contemporary technological society.

Contact Person: ____________________
Title: ____________________
Phone: (   )

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Recognize that good conservation practices depend on understanding the balance between living things and their environment.					
*2. Examine the dynamics of a freshwater system.					
*3. Identify factors that could alter the rate of change in an environment.					
4. Describe how water circulates through the hydrologic cycle.					
5. Discuss the size of our total water supply and its availability.					
6. Identify the sources of rural well water pollution.					
7. List practices to follow in order to assist in reducing water pollution.					

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LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

Submission Date ____________
☐ Original submission ☐ Revision
Page ____ of ____

I. LEARNING AREA *(check one)*
☐ Language Arts
☐ Mathematics
☒ Sciences
☐ Fine Arts
☐ Social Sciences
☐ Physical Development/Health

(Affix label or complete district information.)

COUNTY	DISTRICT	ESC

District Name
City

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will have a working knowledge of the social and environmental implications and limitations of technological development.

Contact Person: ____________
Title: ____________
Phone: ( )

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Understand the impact of technological developments on society.					
*2. Identify the positive effects of establishing a balance of harvest and renewal of our environment.					
*3. Recognize that controversy exists concerning controls versus noncontrols over the application of technology.					
*4. Relate the chemical formation and effects of acid rain.					
5. List the major sources of groundwater contamination.					
6. List practices to follow in order to assist in reducing water pollution.					
7. Identify non-pesticide hazardous water pollution.					

Illinois Agricultural Core Curriculum Rev.

Conserving Water Resources

Agricultural Resources
Environmental Protection

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Environmental Protection

PROBLEM AREA: Conserving Water Resources

STUDENT LEARNING OBJECTIVES

Upon completion of their study of this problem area, students will be able to:

1. Describe how water circulates through the hydrologic cycle.
2. List the major sources of groundwater contamination.
3. Describe the route of agricultural pesticides to groundwater.
4. Identify the health effects of drinking water contaminants.
5. Discuss the size of our total water supply and its availability.
6. Evaluate the history of water use by man and predict future water needs.
7. List practices to follow in order to assist in reducing water pollution.
8. Identify the impacts of acid precipitation.
9. Identify non-pesticide hazardous water pollution.
10. Identify the sources of rural well water pollution.
11. Identify the sources of the Illinois water supply.
12. Identify how water is used in domestic, public, and industrial areas.

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Environmental Protection

PROBLEM AREA: Conserving Water Resources

PROBLEMS AND QUESTIONS FOR STUDY	INSTRUCTOR'S NOTES AND REFERENCES
1. What is the hydrologic cycle?	
2. Why is the hydrologic cycle important?	
3. What is groundwater contamination?	
4. Where does groundwater contamination come from?	
5. How does groundwater contamination occur?	
6. What are the effects of groundwater contamination?	
7. How much water is there for us to use?	
8. Where does the water we use come from?	
9. How do we use water?	
10. Do the uses of water change from one season to another? year? month? One location to another?	
11. Will we use more water in the future?	
12. What practices will assist in reducing water pollution?	
13. What is acid precipitation?	
14. Why is acid precipitation important?	
15. Does acid precipitation affect me as much as some people say it does?	
16. What are specific domestic uses of water?	
17. What are specific public uses of water?	
18. What are specific industrial uses of water?	

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Environmental Protection

PROBLEM AREA: Conserving Water Resources

SUGGESTED TEACHING ACTIVITIES AND PROCEDURES

1. Visit a local sewage treatment plant.
2. Visit a local water treatment plant.
3. Collect water samples, send them in for testing, and analyze the results.
4. Identify water sheds from aerial photos.
5. Visit a farm that controls agricultural sources of water pollution. Your local Soil and Water Conservation District can help arrange the tour.
6. Estimate the amount of water used by students each day.
7. Determine raindrop impact on soil erosion and water pollution (see Student Worksheet #1 in the problem area *Managing Freshwater Resources*).
8. Determine the effect of water runoff on soil erosion and water pollution (see Student Worksheet #1 in *Managing Freshwater Resources*).
9. Determine how many streams or rivers are in a 20-mile radius from your school. Name them.
10. Visit a business site and identify the sources of point and non-point water contamination.

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Environmental Protection

PROBLEM AREA: Conserving Water Resources

REFERENCES

*1. *Environmental Science: How the World Works and Your Place in It.* Person, Jane L. (Rev. 1990). J. M. LeBel Enterprises, 6420 Meadow Creek Drive, Dallas, TX 75240. (214) 661-0687.

*2. *Clean Safe Water, For How Long?* Environmental Protection Agency, Public Information, 2200 Churchill Road, Springfield, IL 62708. (217) 782-3397.

3. *Your Illinois World, A Guide Book to Individual Action on Environmental Action.* Illinois Environmental Protection Agency, Public Information, 2200 Churchill Road, Springfield, IL 62708. (217) 782-3397.

4. *Acid Precipitation.* Soil Conservation Society of America, Water Quality and Management, Illinois Cooperative Extension Service, 67C Mumford Hall, 1301 West Gregory Drive, Urbana, IL 61801. (or local office)

5. *Water Resource Management.* Instructional Materials Service, Texas A & M University, F.E. Box 2588, College Station, TX 77843-2588.

*Indicates highly recommended reference

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTIONAL RESOURCES

These resources are intended for use by teachers in planning and teaching the materials for this problem area and may be adapted to fit the teaching method(s) used.

INFORMATION SHEET #1 — Hydrologic Cycle Terms to be Defined

INFORMATION SHEET #2 — Hydrologic Cycle

INFORMATION SHEET #3 — Urban Storm, Coal Mining, Construction, and Water Pollution

INFORMATION SHEET #4 — Route of Agricultural Pesticides to Groundwater

INFORMATION SHEET #5 — Health Effects of Drinking Water Contaminants

INFORMATION SHEET #6 — Water Fact Sheet

INFORMATION SHEET #7 — History of Water Use By Man

INFORMATION SHEET #8 — What Can You Do to Help Prevent Water Pollution?

INFORMATION SHEET #9 — Impacts of Acid Precipitation

TRANSPARENCY MASTER #1 — Non-Pesticide Hazardous Water Pollutants

TRANSPARENCY MASTER #2 — Farm Well Water Pollution

TRANSPARENCY MASTER #3 — Where Do We Get Our Water From in Illinois?

TRANSPARENCY MASTER #4 — Uses of Water

TRANSPARENCY MASTER #5 — Major Sources of Groundwater Contamination

INFORMATION SHEET #1

Hydrologic Cycle Terms to be Defined

Hydrologic cycle — endless circulation of water from the ocean, atmosphere, and land.

Infiltration — process by which water enters the soil.

Transpiration — process in which water is absorbed by plants through their roots, transported to their leaves, and lost to the atmosphere as a vapor.

Surface runoff — excess water that builds on the soil surface and moves by overland flow.

Through flow or interflow — lateral movement of water through the soil.

Percolation — downward movement of water through the soil.

Saturated zone — area in earth where all spaces between rock and soil are filled with water.

Groundwater — water filling the spaces between soil particles and rock in the saturated zone.

Recharge — process in which water percolating through the soil replenishes groundwater.

Water table — upper boundary or top of the groundwater.

Base flow — groundwater that flows into surface water, such as a lake or river.

Aquifer — permeable, geologic material through which significant quantities of water can move.

Aquitard - geological material through which significant quantities of water cannot move.

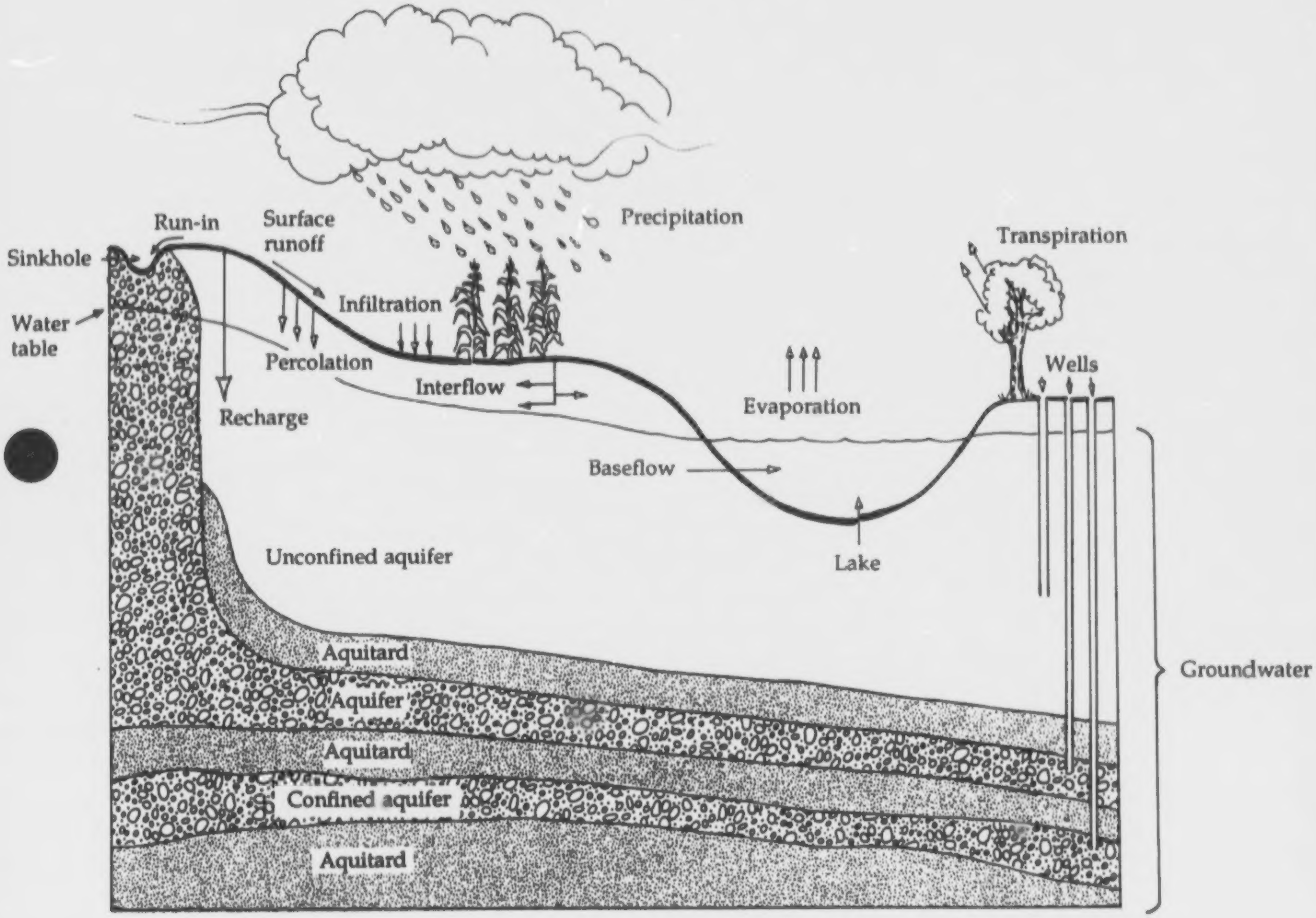
Leaching - process by which contaminants are carried down through the soil to groundwater.

Point contamination sources - well-defined points of entry where pollutants reach a body of water.

Non-point contamination sources - no easily identified points of entry where pollutants reach a body of water.

INFORMATION SHEET #2

Hydrologic Cycle


Run-in
Surface runoff
Precipitation
Transpiration
Sinkhole
Infiltration
Water table
Percolation
Wells
Interflow
Evaporation
Recharge
Baseflow
Lake
Unconfined aquifer
Aquitard
Aquifer
Aquitard
Confined aquifer
Aquitard
Groundwater

INFORMATION SHEET #3

Urban Storm, Coal Mining, Construction, and Water Pollution

Urban Stormwater and Pollution

Urban stormwater runoff carries road salt, lead, oil, grease, and suspended solids into streams or lakes. These compounds are harmful to aquatic life, and in many cases, can be toxic. These materials must also be removed from water by treatment plants before the water can be used for domestic purposes.

Coal Mining and Pollution

Coal is a major economic resource in Illinois. Future removal of all strippable coal reserves in the state would affect approximately 2.6 million acres (seven percent) of Illinois land. Coal resources extend to 86 of Illinois' 102 counties. By 1976, 192,000 acres had been affected by surface mining operations. Water pollution comes from both active and abandoned surface and underground coal mines, where acid mine drainage and sediment from erosion contaminate rivers and streams. Rainwater falling on mine refuse piles forms concentrated sulfuric acid, which is extremely damaging to aquatic life. Excessive corrosion of metal structures such as bridges can occur also.

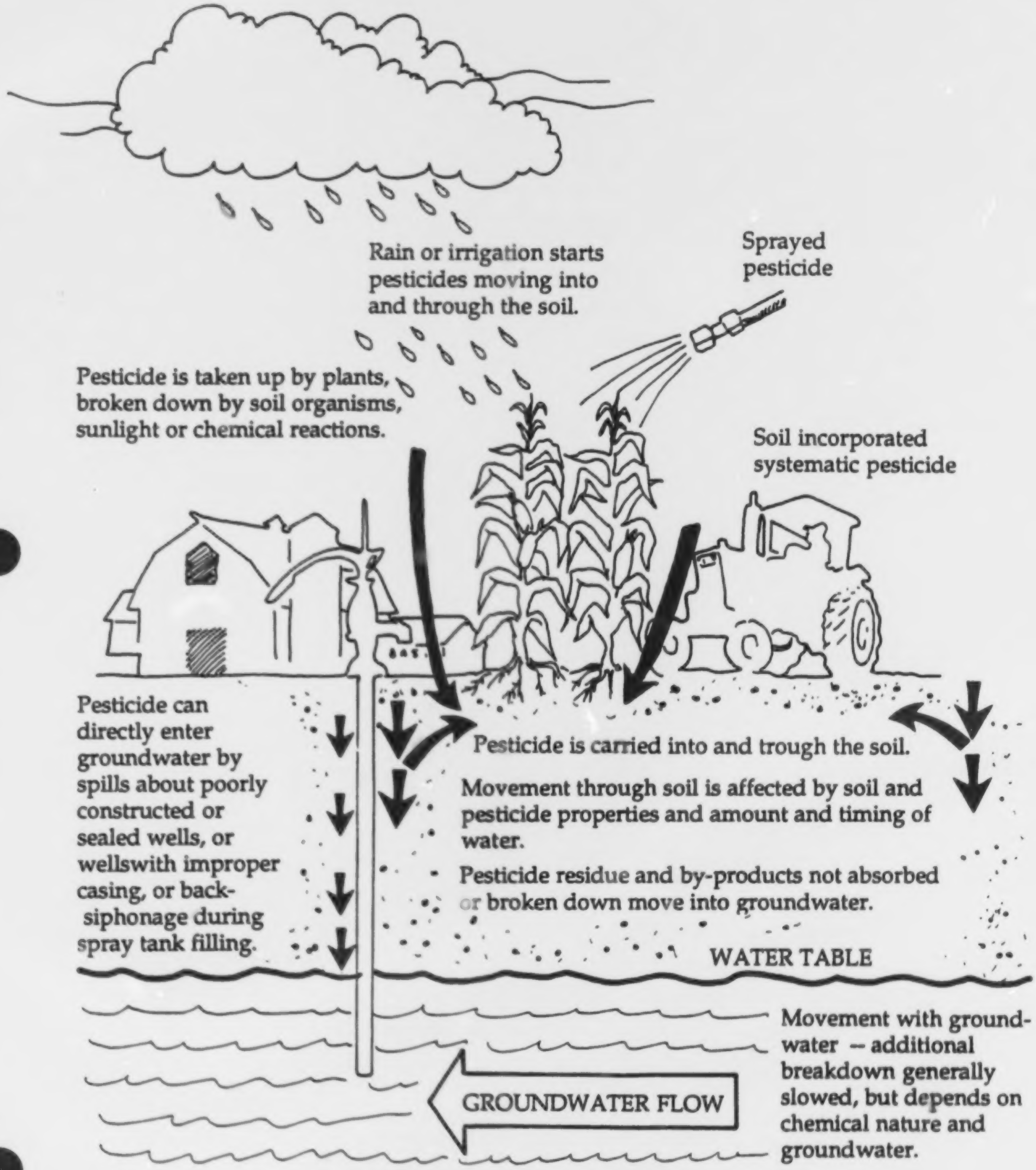
Construction Site Erosion

A large part of urban water pollution is sediment. And although only two to three percent of the soil erosion statewide comes from construction sites, the highly localized problem can be ten times as severe as erosion from farmland. The problem is short-lived, but severe impacts can result on stream life and water quality. Erosion control programs in the future must focus on keeping disturbed areas as small as possible, keeping stormwater runoff velocities low, and retaining sediment within the construction site.

State of Illinois

INFORMATION SHEET #4

Route of Agricultural Pesticides to Groundwater



Rain or irrigation starts pesticides moving into and through the soil.

Sprayed pesticide

Pesticide is taken up by plants, broken down by soil organisms, sunlight or chemical reactions.

Soil incorporated systematic pesticide

Pesticide can directly enter groundwater by spills about poorly constructed or sealed wells, or wellswith improper casing, or back-siphonage during spray tank filling.

Pesticide is carried into and trough the soil.

Movement through soil is affected by soil and pesticide properties and amount and timing of water.

Pesticide residue and by-products not absorbed or broken down move into groundwater.

Movement with ground-water -- additional breakdown generally slowed, but depends on chemical nature and groundwater.

INFORMATION SHEET #5

Health Effects of Drinking Water Contaminants

Regulated Contaminants

Inorganics

Contaminant	Source	Possible chronic health effects
Arsenic	rocks and soil; may contaminate commercial phosphates in fertilizers and laundry detergents; pesticide residues; smelting, glass making, and coal mining	skin and lung cancer; liver and kidney damage
Asbestos	corrosion of asbestos-cement pipe in water distribution systems; manufacture of cement products, paper, floor tiles, paint, caulking, textiles, and plastics	lung cancer; gastrointestinal cancer when swallowed fibers exceed 10μm
Barium	rocks and soil; coal and gas mining; coal burning; diesel fuel combustion and jet fuel; paints, bricks, and tiles	hypertension and heart damage
Cadmium	rocks, coal, and petroleum; by-product of mining, smelting, refining, and electroplating; discarded batteries, paints, and plastics; corrosion of galvanized pipe; landfills and industrial waste sites; fertilizers and sewage sludge	kidney damage
Chromium	rocks and soil; mining sites; chrome plating, cement production; waste incineration; contaminated laundry detergent and bleaches; septic systems	liver, kidney, and lung damage
Copper	rocks and soil; coal burning; iron and steel production; industrial and sewage treatment plant wastes; corrosion of brass and copper pipes	anemia; digestive disturbances; liver and kidney damage
Fluoride	rocks and soil; industrial wastes	mottling of teeth; bone damage
Lead	rocks and soil; corrosion of lead pipes and lead-soldered pipe joints; combustion of leaded gasoline; smelter emissions and discarded storage batteries	brain and nerve damage, especially in children; kidney damage; digestive disturbances; blood disorders; hypertension

Inorganics (continued)

Contaminant	Source	Possible chronic health effects
Mercury	soil and rocks; mining, smelting, coal burning, electrical equipment and fungicides	brain and nerve damage; kidney damage; birth defects and skin rash
Nitrate/Nitrite	soils and mineral deposits; fertilizers, sewage, and animal wastes	Methemoglobinemia in infants

Radioactive Elements

Contaminant	Source	Possible chronic health effects
Gross Alpha Particles	natural decay of uranium in rocks and soil	cancer; bone and kidney damage
Radium-226, -228	natural decay of uranium in rocks and soil	bone cancer; bone and kidney damage; birth defects
Radon	natural decay of uranium in rocks and soil	lung cancer, when released as a gas and inhaled
Uranium	soil and rocks	cancer and kidney damage

Microbial Pathogens

Contaminant	Source	Possible chronic health effects
Coliform Bacteria (an indicator organism for fecal coliform, streptococcal, and other pathogenic bacteria)	sewage, animal wastes; backflow or improper pipe connections in water systems; improperly sealed or constructed wells	gastroenteritis, salmonella infection, dysentery, typhoid fever, and cholera
Giardia lamblia	sewage and animal wastes	giardiasis (a gastrointestinal infection causing diarrhea, abdominal cramps, and gas)

Organics

Contaminant	Source	Possible chronic health effects
Acrylamide	drinking water treatment residue; well drilling; food production and processing; paper making and textile manufacturing	cancer and nervous system effects
Alachlor	agricultural herbicide	cancer; damage to eyes and liver
Aldicarb	agricultural insecticide	cholinesterase inhibition

Organics (continued)

Contaminant	Source	Possible chronic health effects
Benzene	leaking underground fuel storage tanks, industrial wastes; manufacture of pesticides, detergents, and solvents	leukemia and other cancers; nerve, lung, and kidney damage; blood disorders and reproductive effects
Carbofuran	agricultural insecticide	Cholinesterase inhibition; reproductive and immune system effects
Carbon Tetrachloride	chemical disposal sites, contaminated soils, and landfills; aerosol sprays; cleaning agents and coolants; laundry and dry-cleaning operations	cancer; central nervous system depression; liver and kidney damage
Chlordane	insecticide; hazardous waste sites	cancer; nerve and liver effects
2,4 - D	agricultural herbicide and aquatic weeds control	liver and kidney damage; skin irritations and muscle effects
Dibromochloropropane (DBCP)	soil fumigant	cancer; kidney and liver damage; infertility

INFORMATION SHEET #6

Water Fact Sheet

1. Water covers three-fourths of the earth's surface. Most of this is sea water.
2. Every year about 80,000 cubic miles of water evaporate from oceans and about 15,000 cubic miles from land sources.
3. Since the amount of water evaporated and precipitated are almost the same, about 95,000 cubic miles of water are moving between the earth and sky at all times.
4. Precipitation on the land averages 26 inches a year, but it is not evenly distributed. Some places get less than one inch a year and others more than 400 inches.
5. The United States gets about 30 inches a year, or about 4,300 billion gallons a day.
6. Total stream flow from surface to underground sources is about 8.5 inches a year, or about 1,200 billion gallons a day. This is the amount available for human use in homes, industry, irrigation, and recreation.

INFORMATION SHEET #7

History of Water Use By Man

Man can exist on a gallon or so of water a day for drinking, cooking, and washing, though he seldom does or has to.

In medieval times he probably used no more than three to five gallons a day.

In the 19th century, especially in Western nations, he was using about 95 gallons a day.

At present in the United States, man uses about 1,500 gallons a day for his needs and comforts including recreation, cooling, food production, and industrial supply.

In the future?

INFORMATION SHEET #8

What Can You Do to Help Prevent Water Pollution?

Water Pollution
by thy rivers gently flowing

Whenever possible, use soap products instead of detergents.

Do not use full amounts recommended by detergent manufacturers or washer manufacturers. Keep reducing the amount until you find the level required for your needs.

Don't let the water run while you wash dishes, shampoo, or wash your car. Keep water in the refrigerator instead of letting the faucet run to cool water for drinking.

Avoid automatic dishwashers. If you must use one, use it only when full.

Avoid summer watering of lawns. Plant grass varieties and other vegetation that can survive on the natural rainfall in your area.

Fix leaky faucets and toilet tanks that drain continually. Buy tight plugs for basins and tubs.

Don't use toilets as waste disposals. Don't flush tissues, napkins, disposable diapers, cigarette butts, paper towels, or other material.

The average toilet uses five gallons of water on each flush. Reduce the amount by placing a brick in the tank or adjusting the float height. Neither tactic will lessen its efficiency.

Don't use kitchen sink disposal units. They require extra water, put additional loads on sewage treatment plants, and waste organic materials that could be composted.

Don't pour solids such as coffee grounds or grease into drains. Avoid pouring solvents, medicines, and other chemicals down the drain, especially caustics or poisons which may affect biological processes at waste treatment plants. Use mechanical means (plungers, probes) to clear clogged pipes.

Discourage the use of continually running decorative fountains unless they recirculate the water. Object to continually running drinking fountains in parks, public buildings, and offices.

Discourage street washing with water sprays. Modern rotary brooms work equally well.

Do not use a hose to clean sidewalks, porches, patios or driveways. Again, a broom is equally efficient and often saves time.

Shovel away snow and ice. Use a heavy bladed tool to break up ice patches. Avoid spreading salt which is harmful to vegetation and pollutes waterways when washed into sewers. Use sand sparingly if a substitute is needed.

Argue against municipal use of salt on winter streets, for the same reasons. Cinders and sand could be used sparingly as substitutes. Excess amounts should be swept up from dry streets to avoid washing into sewer systems.

Promote mandatory sewage system connections for homes. Discourage use of septic tanks except in wholly rural areas.

Support plans for regional waste water treatment systems for more efficiency at lower cost.

Encourage local industries to recirculate water used for cooling machinery, and to treat and reuse process water wherever possible.

Organize group cleanups of litter on the banks of local streams and lakes. Don't ever throw trash in water. When boating, insist on use of chemical toilets and sanitary disposal facilities in docking areas.

Support subdivision, agricultural, and zoning ordinances which reduce erosion and siltation of waterways. Promote restrictions against development on flood plains, steep slopes, marshes, and coastal wetlands.

Reduce or eliminate use of chemical fertilizers and weedkillers for lawn or garden. Support reasonable restrictions on their agricultural use.

Report apparent incidents of water pollution to local and state authorities.

State of Illinois

INFORMATION SHEET #9

Impacts of Acid Precipitation

Aquatic environments — In watersheds that lack neutralizing or buffering capacities, acid precipitation alters the chemical properties of water entering streams and lakes.

Agriculture — As soils become more acid, metals in them become more soluble, which may increase the metal content of water supplies.

Forests — Effects of acid precipitation and other pollutants on forest ecosystems are extremely complex and, therefore, difficult to quantify and demonstrate.

Man-made structures — Corrosive damage to stone masonry, steel, and other metal products have been linked to acid precipitation.

Health — Air pollution likely contributes to heart disease, lung disease, and cancer.

TRANSPARENCY MASTER #1

Non-Pesticide Hazardous Water Pollutants

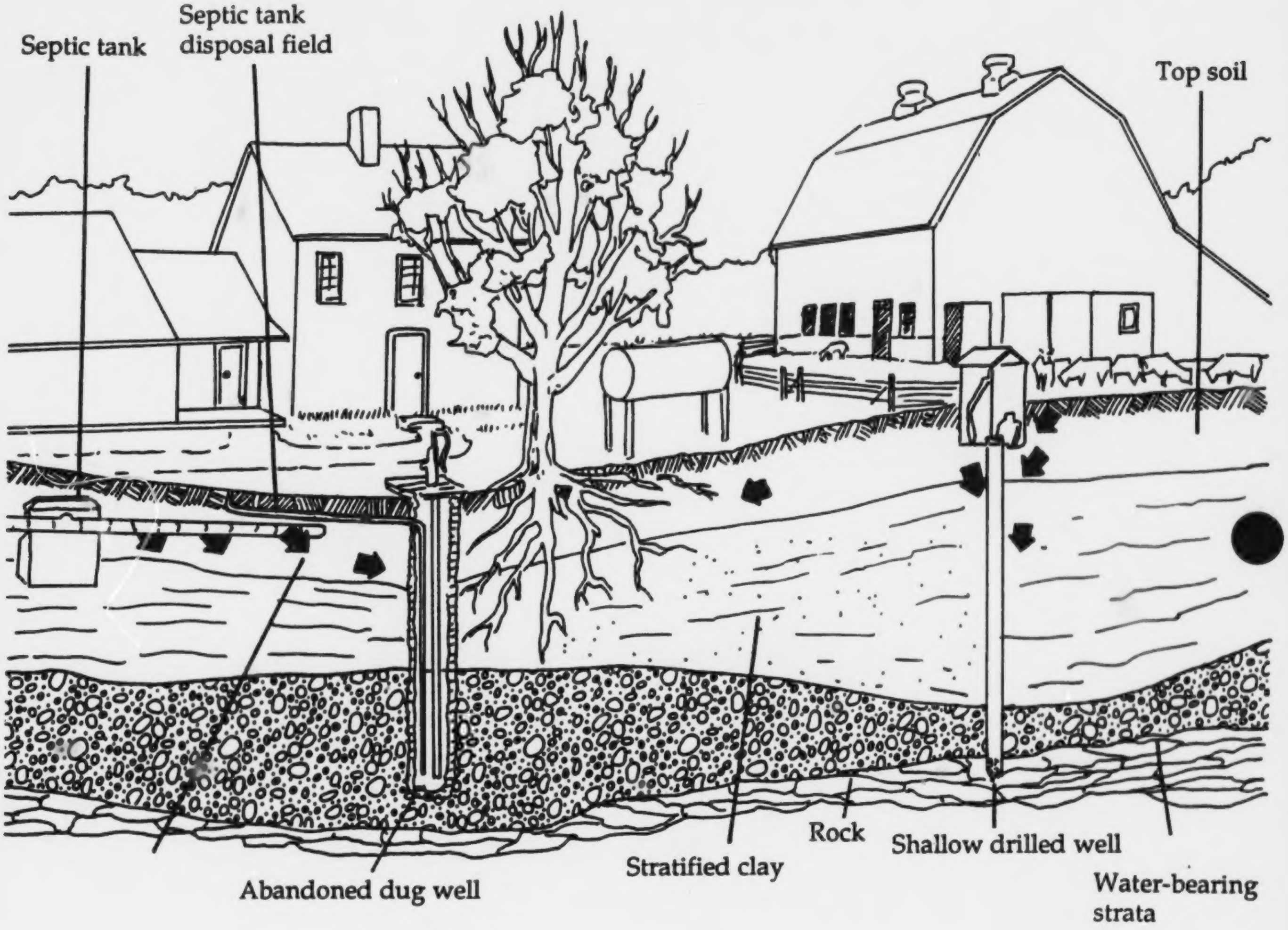
Pesticides are not the only substances on a farm that pose some risk to groundwater and the environment. The following are examples of common items which should be disposed of in licensed hazardous waste landfills:

ammunition
antifreeze
auto transmission fluid
batteries and battery acid
brake fluid
fuels, including diesel, fuel oil, and kerosene
oils, including cutting oils
oil-base paints
paint thinners, strippers, cleaners, and solvents
rust remover
turpentine
varnish
wood preservatives

Illinois Cooperative Extension Service

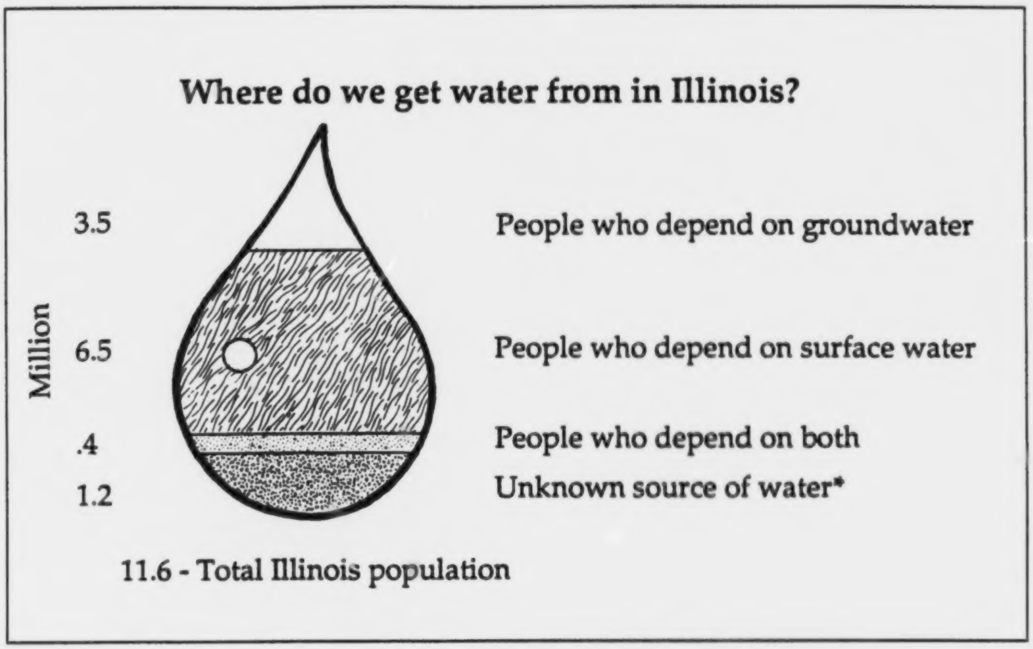
TRANSPARENCY MASTER #2

Farm Well Water Pollution


Septic tank
Septic tank disposal field
Top soil
Rock
Shallow drilled well
Stratified clay
Abandoned dug well
Water-bearing strata

TRANSPARENCY MASTER #3

Where Do We Get Our Water From in Illinois?



*This figure represents mostly rural people, who have their own supply of water. Most of this water comes from groundwater. Source: *Water Withdrawals in Illinois*, by James R. Kirk, Illinois State Water Survey, 1987.

Illinois Cooperative Extension Service

TRANSPARENCY MASTER #4

Uses of Water

Domestic Use

Food	drinking, ice making, cooking, canning, etc.
Cleaning	bathing, laundering, mopping, washing dishes, foodstuffs, automobiles
Sanitation	flushing of plumbing fixtures, household scrubbing
Lawns	watering of lawns, flowers, shrubs
Evaporative cooling	cooling of homes, greenhouses, etc.

Public Use

Fire protection	homes, businesses, etc.
Recreation	swimming, boating, fishing, camping, picnics, etc.

Industrial Use

Manufacturing	drinking and decorative fountains, processing foods and drinks, cooling, heating, carrying off waste products

TRANSPARENCY MASTER #5

Major Sources of Groundwater Contamination

1. Disposal of solid and liquid wastes
2. Underground pipelines and storage tanks
3. Animal feed lots
4. Abandoned wells
5. Septic tanks, cesspools, privies
6. Overdevelopment
7. Holding ponds and lagoons
8. Fertilizers and pesticides
9. Accidental spills of hazardous materials

STUDENT ACTIVITIES

STUDENT WORKSHEET #1 – Examination of Clean Water Issues

For additional activities, teachers may refer to the "Suggested Teaching Activities and Procedures" section in the Instructor's Guide.

STUDENT WORKSHEET #1

Examination of Clean Water Issues

Note to teacher: *This is a planning simulation exercise for water pollution controls. Students are urged to role play and BE the planners for the state. Approximate time: 1 ½ hours.*

Materials:

1. Blackboard
2. Easel with large pad of paper
3. Marking pens

Activity:

1. Ask students to name sources of water pollution. List these on a blackboard. (Examples: pesticides, runoff from city streets and parking lots, domestic sewage, industrial wastes, fertilizers, soil erosion, runoff from mines, construction site runoff, litter, etc.)

2. Divide these sources of water pollution into major categories based on social groups in your community. For example, construction businesses and homebuilders would be interested in construction site runoff; farmers would be interested in pesticides, fertilizers, and soil erosion; industries would be concerned with industrial sources of water pollution. Divide the class into groups, appointing them as the planning agency for agriculture, industry, construction sites, mining, etc.

3. Ask each group to list the water pollution problems they cause, the economic problems in solving their source of pollution, who would be affected, and how to control their source of water pollution. Have them use a visual aid.

4. Point out conflicts in controlling sources of pollution. (Example: If industry installs water pollution control devices, the cost of this must be passed on to the consumer. What will the consumer say? To control soil erosion from agriculture may mean extra costs to the farmer, but unlike industry, he cannot pass on the costs to the consumers. What will the farmer do?)

5. Ask each group to develop a comprehensive plan based on all of the presentations.

6. Ask each group to present their plan to the class. Discuss differences, similarities, etc. Point out that planning for the control of water pollution goes through the same process, and must take into consideration political, economic, environmental, and social factors. Planning for water pollution abatement isn't a simple process, is it?

State of Illinois

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Environmental Protection

PROBLEM AREA: Controlling Air Pollution

RELATED PROBLEM AREAS:

1. Understanding Governmental Regulations and Controls
2. Conserving Water Resources
3. Understanding the Relationship Between Agriculture and the Environment (Central Core Cluster)
4. Utilizing Energy Efficiently (Central Core Cluster)
5. Utilizing Energy Alternatives (Horticulture Cluster)
6. Conserving Soil (Agricultural Business and Management Cluster)

PREREQUISITE PROBLEM AREA(S): None

LEVEL: Orientation

OCCUPATIONAL TASKS ADDRESSED:

Agricultural Resources Cluster

Duty B: Applying Laws, Regulations, and Policies

1. Report violations to proper authorities
2. Interpret Environmental Protection Agency (EPA) regulations

Duty F: Using Tools, Materials, and Equipment

1. Perform preventative maintenance on equipment

Duty H: Applying Safety Practices

1. Monitor equipment for safe operation

STATE GOALS FOR LEARNING

In planning the instruction for this problem area, teachers can promote the development of several student learning objectives which are related to the State Goals for Learning in Biological and Physical Sciences and Social Sciences. These objectives are listed on the Learning Assessment Plan forms included on the following page(s). Those learning objectives marked with an asterisk (*) are taken from the sample lists provided by the Illinois State Board of Education.

CORE

Illinois Agricultural Core Curriculum

Agricultural Education 124 Mumford Hall 1301 W. Gregory Drive University of Illinois Urbana, IL 61801

Director: Dale A. Law, Ed.D.
Principal Investigator: Jerry D. Pepple, Ed.D
Research Assistant: Kevin J. Enderlin

Illinois Agricultural Core Curriculum Rev.

Submission Date____________________

☐ **Original submission** ☐ **Revision**

Page ____ of ____

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

(Affix label or complete district information.)

COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐

District Name

City

I. LEARNING AREA *(check one)*

☐ Language Arts
☐ Mathematics
☒ Sciences
☐ Fine Arts
☐ Social Sciences
☐ Physical Development/Health

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will have a working knowledge of the concepts and basic vocabulary of biological, physical, and environmental sciences and their application to life and work in contemporary technological society.

Contact Person: ____________________

Title: ____________________

Phone: (   )

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Know the carbon, oxygen, and nitrogen cycles.					
*2. Identify factors which influence weather.					
*3. Know that the earth is a closed system in space with limited resources.					
4. Identify and name the layers of the atmosphere.					
5. List the constituents in the normal composition of unpolluted air.					
6. Discuss how ozone reduces the amount of ultraviolet rays that reach the earth's surface and how air pollutants destroy the ozone layer.					
7. Identify and describe methods used by industry to improve air quality.					
47				48	

ISBE 41-78 (1/88)

Agricultural Resources
Environmental Protection

Controlling Air Pollution

Submission Date ______________
☐ Original submission ☐ Revision
Page ____ of ____

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(Affix label or complete district information.)

COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐

District Name

City

I. LEARNING AREA *(check one)*

☐ Language Arts ☐ Fine Arts
☐ Mathematics ☐ Social Sciences
☒ Sciences ☐ Physical Development/Health

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will have a working knowledge of the social and environmental implications of technological development.

Contact Person: ______________
Title: ______________
Phone: (   )

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Understand ways that people can minimize the depletion of the earth's resources.					
*2. Understand the impact of technological developments on society.					
*3. Understand potential consequences resulting from interaction between technological advances and the environment.					
4. Identify actions that can be taken by individuals to improve air quality.					
5. List and describe the five primary air pollutants and identify their major sources.					
6. Define air pollution.					
7. Understand how wind patterns affect the buildup of air pollution from city to city or country to country.					

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

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Submission Date________________
☐ Original submission ☐ Revision
Page ____ of ____

I. LEARNING AREA *(check one)*
☐ Language Arts ☐ Fine Arts
☐ Mathematics ☒ Social Sciences
☐ Sciences ☐ Physical Development/Health

(Affix label or complete district information.)

COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐

District Name
City

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will be able to apply the skills and knowledge gained in the social sciences to decision making in life situations.

Contact Person: ________________
Title: ________________
Phone: (   )

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Understand the knowledge and skills required for success in selected fields of work.					
*2. Recognize that competence in a field of work entails the development of a wide range of skills.					
3. Identify and name the layers of the atmosphere.					
4. Identify reasons for needing international air pollution control.					
5. Describe correctly the greenhouse effect and how it is caused.					

ISBE 41-78 (1/88)

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

Submission Date ____________________
☐ **Original submission** ☐ **Revision**
Page _____ of _____

I. LEARNING AREA *(check one)*

☐ Language Arts ☐ Fine Arts
☐ Mathematics ☒ Social Sciences
☐ Sciences ☐ Physical Development/Health

(Affix label or complete district information.)

COUNTY	DISTRICT	ESC

District Name
City
Contact Person: ____________________
Title: ____________________
Phone: (   )

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will be able to understand and analyze comparative political and economic systems, with an emphasis on the political and economic systems of the United States.

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Evaluate the economic impact of political decisions made by federal, state, and local governments.					
2. Identify reasons for needing international air pollution control.					
3. Identify legislation which has caused the improvement of air quality in the United States.					
4. Define primary and secondary air quality standards.					
53					54

ISBE 41-78 (1/88)

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Environmental Protection

PROBLEM AREA: Controlling Air Pollution

STUDENT LEARNING OBJECTIVES

Upon completion of their study of this problem area, students will be able to:

1. Discuss the importance of air to people.
2. Identify and name the layers of the atmosphere.
3. List the constituents in the normal composition of unpolluted air.
4. Define air pollution.
5. Understand how wind patterns affect the buildup of air pollution from city to city or country to country.
6. List and describe the five primary air pollutants and identify their major sources.
7. Discuss how ozone reduces the amount of ultraviolet rays that reach the earth's surface and how air pollutants destroy the ozone layer.
8. Describe correctly the greenhouse effect and how it is caused.
9. Identify reasons for needing international air pollution control.
10. Identify legislation which has caused the improvement of air quality in the United States.
11. Define primary and secondary air quality standards.
12. Describe how air quality has improved in the workplace.
13. Discuss how air quality has improved over the past ten years.
14. Identify and describe methods used by industry to improve air quality.
15. Identify possible health hazards of polluted air.
16. Identify actions that can be taken by individuals to improve air quality.

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Environmental Protection

PROBLEM AREA: Controlling Air Pollution

PROBLEMS AND QUESTIONS FOR STUDY

INSTRUCTOR'S NOTES AND REFERENCES

1. Why is air important to people?
2. What is the atmosphere?
3. What is air?
4. What is air pollution?
5. Does air pollution remain in the area in which it originated?
6. What are the types of air pollution?
7. What are the major sources of air pollution?
8. What is the ozone layer?
9. What is the greenhouse effect?
10. What is the government doing to improve air quality?
11. What is the difference between primary and secondary air quality standards?
12. Is air quality in the workplace an important aspect of air pollution?
13. Is air quality improving or worsening?
14. What is industry doing to improve air quality?
15. Are there any health problems caused by air pollution?
16. What can an individual do to improve air quality?

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Environmental Protection

PROBLEM AREA: Controlling Air Pollution

SUGGESTED TEACHING ACTIVITIES AND PROCEDURES

1. Arrange for students to visit a nearby agricultural industry and observe air pollution control. Determine the kind of pollution produced and the extent of control. Discuss the adequacy of control measures. Examples of industries to visit include fertilizer manufacturing plants and paper manufacturing plants.

2. Have students visit a nearby farm and observe sources of air pollution. Determine the control measures being used and discuss other possible control measures.

3. Have students observe sources of air pollution at their home.

4. Discuss the implication of air pollution on humankind.

5. Invite local government officials to speak to the class. Ask them about their plans to control pollution.

6. Invite a local city or county official to expalin local regulations concerning air pollution such as residential burning and vehicle emissions.

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Environmental Protection

PROBLEM AREA: Controlling Air Pollution

REFERENCES

*1. *Introduction to Environmental Science.* Moran, Morgan, Wiersman. W. H. Freeman and Company, 4419 W. 1980 S., Salt Lake City, UT 84104.

2. *Environmental Science.* Enger, Kormelink, Smith, Smith. Wm. C. Brown Publishers, 2460 Kerper Blvd. Dubuque, IA 52001.

*3. *Your Illinois World.* A guidebook to individual action on environmental concerns. Illinois EPA, Public Information, 2200 Churchill Rd., Springfield, IL 62708 (217) 782-3397

*Indicates highly recommended reference

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTIONAL RESOURCES

These resources are intended for use by teachers in planning and teaching the materials for this problem area and may be adapted to fit the teaching method(s) used.

INFORMATION SHEET #1 — Our Ocean of Air

INFORMATION SHEET #2 — Air Pollution

INFORMATION SHEET #3 — Primary Air Pollutants

INFORMATION SHEET #4 — Pollutants and Effects

INFORMATION SHEET #5 — Secondary Air Pollutants

INFORMATION SHEET #6 — Ozone

INFORMATION SHEET #7 — Carbon Dioxide and the Greenhouse Effect

INFORMATION SHEET #8 — International Air Pollution

INFORMATION SHEET #9 — Air Quality Legislation

INFORMATION SHEET #10 — Air Quality Standards

INFORMATION SHEET #11 — Air Quality in the Workplace

INFORMATION SHEET #12 — Trends in Air Quality

INFORMATION SHEET #13 — Air Quality Control

INFORMATION SHEET #14 — Industrial Control Technologies

INFORMATION SHEET #15 — Various Technologies Available to Lower Emissions of Sulfur Dioxide

INFORMATION SHEET #16 — Control of Motor Vehicle Emissions

INFORMATION SHEET #17 — Air and Health

INFORMATION SHEET #18 — What Can You Do to Improve Air Quality?

TRANSPARENCY MASTER #1 — Global Wind Patterns

TRANSPARENCY MASTER #2 — Accumulation of Pollutants

TRANSPARENCY MASTER #3 — Sources of Air Pollution

TRANSPARENCY MASTER #4 — Greenhouse Effect

TRANSPARENCY MASTER #5 — Control Techniques for Indoor Air Quality

TRANSPARENCY MASTER #6 — Pollutant Standards Index of Air Quality

TRANSPARENCY MASTER #7 — Motor Vehicle Carbon Monoxide Emissions

TRANSPARENCY MASTER #8 — Trend in Pollutant Standards Index in the United States

TRANSPARENCY MASTER #9 — Smokestack Effect

TRANSPARENCY MASTER #10 — Cost and Capability of Various Collectors

TRANSPARENCY MASTER #11 — Cyclone Particulate Collector

TRANSPARENCY MASTER #12 — Industrial Baghouse Compartment for Removal of Particulates

TRANSPARENCY MASTER #13 — Catalytic Converter

60

INFORMATION SHEET #1

Our Ocean of Air

We can go a few hours or even a few days without food or water, but we cannot go without air for even a few minutes or we will die. We can look at some of the important things which scientists have found out about our ocean of air. They have found how it can be made to work for us so that many things we do are made easier. They have also found that it has a lot to do with how we feel and act. They now know that the atmosphere has a lot to do with our weather, too. There are still many things scientists do not know about our atmosphere. As they learn to understand it more, the atmosphere will be made to do many more useful things for us.

Our atmosphere covers the earth like the pericarp covers the fruit of an orange. The atmosphere reaches out into space for a distance of about 20,000 miles or more.

The atmosphere is divided into several different layers. Scientists have found that about one-half of all the air which is around the earth is in a layer within three and a half miles of the earth's surface. The reason for this is that the earth's gravity pulls on the air.

This diagram will give you some idea about how scientists have divided the atmosphere into several layers.

INFORMATION SHEET #2

Air Pollution

Pollution is material produced, both man-made and natural, that interferes with our well-being. If it were possible to live as single-family units on farms where each family would grow its own food, air pollution probably would not be a problem. The amount of waste put into the air would be diluted, so no one's air quality would be seriously altered.

However, we are an urbanized, industrialized civilization with a growing population and a history of increasing use of fossil fuels and technological aids. When we manufacture the products needed by this concentrated population, we also produce by-products and release them into our environment.

The atmosphere is normally composed of 79 percent nitrogen, 20 percent oxygen, and a one percent mixture of carbon dioxide, water vapor, and small quantities of several other gases.

Air in the atmosphere is constantly circulating because of heating and cooling and the fact that the earth is spinning on its axis. The combination of air movements creates specific wind patterns that are characteristic of different regions of the world. Therefore, gases or small particles released into the atmosphere are likely to be mixed, diluted, and circulated, but are likely to stay near the earth due to gravity.

When we put material into the air, we do not get rid of it; we just dilute it and move it out of the immediate area. In industrialized urban areas, the pollutants cannot always be diluted before the air reaches another city. The polluted air from Chicago is further polluted in Gary, Indiana, and so on. While not every population center adds the same kind or amount of waste, each adds to the total load carried.

INFORMATION SHEET #3

Primary Air Pollutants

There are five major types of materials released into the atmosphere in sufficient quantities that in their unmodified form are considered to be primary pollutants. They are as follows:

1. Carbon monoxide (CO) — Carbon monoxide is produced when organic materials, such as gasoline, coal, wood, or trash are incompletely burned. The automobile is responsible for most of the carbon monoxide produced in cities. The next largest source is from the incomplete combustion of smoking tobacco. Fortunately, carbon monoxide is not a persistent pollutant. It seems that natural processes connect carbon monoxide to other compounds that are not harmful.

2. Hydrocarbons (HC) — Hydrocarbons are a group of organic compounds consisting of carbon and hydrogen atoms. They either evaporate from fuel supplies, or are remnants of the fuel that did not burn completely. Undoubtedly the internal combustion engine is the major culprit, although refineries and other industries do add hydrocarbons to the total atmospheric burden.

   Hydrocarbons in the atmosphere should be no great problem. Most of them are washed out of the air when it rains and run off into surface water. They do cause an oil film on surfaces, but do not generally cause more than a nuisance problem.

3. Particulates — Particulates constitute the third largest category of air pollutants. These are small pieces of solid material that are dispersed into the atmosphere. Smoke particles from fires, bits of asbestos from brake linings and insulation, dust particles, and ash from industrial plants contribute to the particle load. Particles cause problems ranging from the annoyance of soot settling on your backyard picnic table, to the cancer-causing effects of asbestos. Particulates frequently get a lot of attention because they are so readily detected by the general public. The heavy black smoke from a factory can be seen by everyone, whereas the production of colorless gases like carbon monoxide and sulfur dioxide goes unnoticed.

4. Sulfur dioxide (SO_2) — Sulfur dioxide is a compound containing sulfur and oxygen that is produced when sulfur-containing fossil fuels are burned. Coal and oil are produced from organisms that had sulfur as one of the component parts of their living structure. When coal and oil were formed, some of the sulfur was incorporated into the fossil fuel. As the fuel is burned, some of the sulfur is released as sulfur dioxide. Sulfur dioxide has a sharp odor and irritates respiratory tissue. It also reacts with water, oxygen, and other materials in the air to form sulfur-containing acids. The acids can be attached to particles. When inhaled, such particles are very corrosive to lung tissue.

5. Oxides of nitrogen (NO and NO_2) — Oxides of nitrogen are also major primary air pollutants. They consist of a variety of different compounds containing nitrogen and oxygen. When combustion takes place in the air, the nitrogen and oxygen molecules from the air may react with each other.

   $N_2 + O_2 = 2NO$ nitrogen oxide

   $2NO + O_2 = 2NO_2$ nitrogen dioxide

   These nitrogen compounds produce a reddish brown color in the atmosphere and react with other compounds to produce photochemical smog. The primary source of nitrogen oxide is the automobile engine. Nitrogen oxides are involved in the production of secondary pollutants.

INFORMATION SHEET #4

Pollutants and Effects

Pollutant	Major sources	Principal effects
Total gaseous hydrocarbons	Fuel combustion, industrial processes, evaporation of hydrocarbons	Visibility reduction, plant damage, and sensory irritation caused by photochemical reactions involving reactive hydrocarbons; ethylene itself causes plant damage
Nitrogen oxide (nitric oxide and nitrogenic dioxide)	Fuel combustion, industrial processes	Visibility reduction, plant damage, and sensory irritation caused by photochemical reactions involving nitrogen oxide; these gases may also cause adverse health effects, and nitrogen dioxide can cause decreased visibility
Total aliphatic aldehydes, formaldehydes, and acrolein	Fuel combustion, incineration of wastes, atmospheric photochemical reactions	Sensory irritation, plant damage, visibility reduction, and possible adverse effects on health
Carbon dioxide	Combustion processes	Used as an index of pollution from combustion operations
Suspended particulate matter	Combustion, and industrial and natural processes	Visibility reduction, soiling
Hydrogen sulfide	Coke, distillation of tar, petroleum and natural gas refining, manufacture of viscose rayon, and certain chemical processes	Odor nuisances, caused deaths in Puerto Rico and Mexico when large quantities escaped from units of natural gas refining plants
Hydrogen fluoride	Heating to high temperature of ores, clays or fluxes containing fluorine; generally from steel mills, ceramic works, aluminum reduction plants, and superphosphate factories	Damage to citrus and certain other agriculture plants and flowers; affects teeth and bones of cattle when forage crops have been consumed
Lead	Internal combustion engines, industrial emissions, open burning of wood coated with lead paint	Lead poisoning
Sulphur dioxide	Fuel combustion (coal, oil, cellulosic material), industrial processes	Sensory and respiratory irritation, plant damage, corrosion, possible adverse effects on health
Oxidants	Atmospheric photochemical reactions involving nitrogen oxides, organic gases, vapors, and solar radiation	Sensory and respiratory irritation, plant damage; provides, indirectly, an index of visibility reduction due to photochemical aerosols, possible adverse effects on health
Carbon monoxide	Gasoline-powered vehicles, fuel combustion, industrial processes	Reduction in the oxygen-carrying capacity of blood.

Illinois Environmental Protection Agency

INFORMATION SHEET #5

Secondary Air Pollutants

Secondary pollutants are compounds that result when pollutants react with each other. Photochemical smog is the result of the interaction of hydrocarbons, oxides of nitrogen, and sunlight, which produces a yellowish brown haze. Photochemical smog is a mixture of complex organic compounds that irritate respiratory tissue and eye membranes and stimulate the production of tears. People who live in areas where smog is common have more health problems than do those who live in less polluted areas. These areas also show altered plant growth.

INFORMATION SHEET #6

Ozone

In the 1970s scientists became concerned about the possible reduction of the ozone layer surrounding the earth. The presence of ozone in the outer layers of the atmosphere shields the earth from the harmful effects of ultraviolet radiation.

Ozone is a molecule that consists of three atoms of oxygen. This molecule in the presence of ultraviolet light is split into an oxygen atom and an oxygen molecule.

$$O_3 \xrightarrow{\text{uv light}} O_2 + O$$

Oxygen molecules are also split by ultraviolet light to form oxygen atoms.

$$O_2 \xrightarrow{\text{uv light}} 2O$$

The recombination of oxygen atoms and oxygen molecules forms ozone.

$$O_2 + O \rightarrow O_3$$

These reactions absorb 99 percent of the ultraviolet energy from the sun, so it does not reach the earth's surface. Destruction of the ozone layer would increase the amount of ultraviolet light at the earth's surface. This increase of ultraviolet light would result in increased mutations in plants and animals and an increase in skin cancer.

The use of chloro-fluorocarbons (Freon) as refrigerator gases and as aerosol propellants has resulted in the release of large amounts of these reactive molecules into the atmosphere. It was discovered that ultraviolet radiation splits the chlorine atoms from the chloro-fluorocarbon molecule. The free chlorine atoms then react with ozone molecules and break them into molecular oxygen.

$$2O_3 \xrightarrow[\text{atoms}]{\text{chlorine}} 3O_2$$

Concern about the ozone layer led to the ban on the use of Freon in aerosol containers in the United States. Even though several other countries (Sweden, Denmark, and Canada) have similar bans, most nations still permit the unrestricted use of Freon.

INFORMATION SHEET #7

Carbon Dioxide and the Greenhouse Effect

In addition to sulfur dioxide, nitrogen dioxide, and carbon monoxide, combustion of fossil fuels releases large amounts of carbon dioxide (CO_2). Carbon dioxide is a normal component of the earth's atmosphere. Plants trap carbon dioxide through the process of photosynthesis and convert it into plant tissue. However, there has been much speculation about the effects of artificially elevated levels of carbon dioxide in the atmosphere. Carbon dioxide allows light energy to pass through the atmosphere, but prevents heat from leaving. In many respects this is similar to what happens in a greenhouse, so it has been called the greenhouse effect.

INFORMATION SHEET #8

International Air Pollution

Acid rain originates as a form of air pollution, but it may damage the environment in the form of water pollution. Also, air pollution may originate in one country and water pollution may be formed in another.

A particular nation may have stringent environmental controls within its own boundaries, but have environmental problems because of the actions of a neighboring country.

Recently the phenomenon of acid rain has underscored the need for international cooperation in dealing with various environmental concerns. For example, an estimated 55 percent of the acid rain falling in Sweden originated outside of the country. Since the 1930s, the lakes in western Sweden have become more acidic by a value of two pH points.

In the 1950s the United Kingdom initiated a program to reduce air pollution. This program has been successful in that air in the United Kingdom has become cleaner. But one of the solutions was to build taller smokestacks. As a result, more of the pollutants from the United Kingdom are transported to Sweden.

INFORMATION SHEET #9

Air Quality Legislation

All those adverse effects of air pollution have spurned a national effort to improve air quality. Today, in most areas of our nation, we breathe air that is significantly healthier for us than it was only a decade ago. Much of this improvement stems from strong pollution-control legislation and new air quality control strategies. But advances in air quality are costly, and efforts to achieve cleaner air have been met with some resistance.

1955 — Federal law provided funds for research on polluted air by the U.S. Public Health Service and decreed that states be provided with technical information that was compiled in that effort.

1963 — Clean Air Act was passed, which expanded federally sponsored research on air pollution. The law also provided funds to the states to help them carry out their then meager control programs.

1965 — First nationwide standards for automobile exhaust emissions were established. The legislation called for the reduction of carbon monoxide and hydrocarbon emissions in new automobiles by 1968. It also directed the Surgeon General to study the effects of automobile emissions on human health.

1967 — Air Quality Act was passed. That law set goals for air quality and called for state and federal standards, although enforcement rested with individual states.

1970 — Amendments to the Clear Air Act called on the EPA to develop uniform air quality standards for outdoor air in 247 air-quality control regions nationwide. Each air-quality control region encompasses an area where at least two communities share common air-pollution problems.

1970 — Amendments also required states to draw up state implementation plans and to enforce air-quality standards for stationary sources such as incinerators, factories, and power plants.

INFORMATION SHEET #10

Air Quality Standards

Two sets of standards were established by the 1970 amendments.

1. Primary air-quality standards — The maximum exposure levels that can be tolerated by human beings without ill effects.

2. Secondary air-quality standards — The maximum levels of air pollutants that are allowable to minimize the impact on materials, visibility, personal comfort, and climate.

INFORMATION SHEET #11

Air Quality in the Workplace

In addition to regulating ambient (outdoor) air quality, federal legislation also attempts to control air quality in the workplace. The importance of controls in the workplace is underscored by a survey of more than 4,500 industrial plants. The survey showed that 25 percent of nearly one million workers in those plants were exposed to substances that were capable of causing illness or death. Congress took steps to reduce occupational exposure to dangerous substances by enacting the Occupational Safety and Health Act in 1970. The law directed the labor department to set acceptable levels of exposure, to monitor causes of illness and injury in workers, and to establish training programs that promote on-the-job safety. Many workplace locations are now banned as areas for smoking. Smokers are required to go to certain locations, sometimes outside the building, in order to smoke.

INFORMATION SHEET #12

Trends in Air Quality

The effectiveness of air-quality legislation and the response of industry in lowering the nation's air pollution problems is becoming apparent. Overall, much progress has been made in improving outdoor air quality and reducing motor vehicle emissions.

- In 23 United States metropolitan areas for which Pollution Standard Indexes are available, the average frequency of unhealthy air-quality days declined from 1974 through 1980.

- Emission controls on motor vehicles have substantially decreased the emissions of carbon monoxide and hydrocarbons.

- Less burning of leaded gasoline has greatly reduced the amount of lead particles in the air.

INFORMATION SHEET #13

Air Quality Control

Taller Stacks

An increasingly popular industrial strategy that is used to control air quality is to construct taller smokestacks. That strategy is one of the approaches that is taken by industry in Green Bay, Wisconsin, to combat the area's sulfur dioxide problem.

Taller smokestacks reduce local concentrations of ground level air pollutants, but do not improve regional air quality, because they do not reduce the total quantity of pollutants that enter the atmosphere.

Relocation

An alternative strategy that is used to control air quality is to locate new industrial sources of air pollution in rural sites rather than urban ones. This strategy also does not reduce the total amount of pollutants that enter the atmosphere.

INFORMATION SHEET #14

Industrial Control Technologies

Many industries have adopted a wide variety of technologies in an effort to lower their contribution to polluted air.

Particulates

Three methods of removing particulates from stack emissions are currently available.

1. Electrostatic precipitators — Particles are electrically charged and then collected on plates that have the opposite charge. This process can remove 99 percent of the fly-ash emissions from the stacks of coal-fired power plants.

2. Filtering — A particle-laden air stream passes through a series of filters, most of which are composed of fiberglass. The filters are porous enough to allow gases to pass through, while trapping the particles behind.

3. Cyclone collector — This type of collector induces gravitational settling of heavier particles. By using these techniques some industries have reduced their particle emissions by 90 percent.

Sulfur Dioxide

In recent years, some industries have made much progress in reducing sulfur dioxide emissions. Flue-gas desulfurization (scrubbing), a technique used to reduce sulfur dioxide emissions, is described below.

Scrubbing is the most common method of controlling sulfur dioxide emissions. In scrubbing the effluents are channeled through a slurry of water and ground limestone. Through this process, the calcium in the limestone combines chemically with the sulfur to produce calcium sulfate. Up to 90 percent of the sulfur dioxides in flue gases can be removed this way.

Oxides of Nitrogen

Unlike emissions of other major pollutants, industrial emissions of oxides of nitrogen are still rising. Several promising industrial control strategies for NO_x are currently under study.

One industrial approach to NO_x control is *staged combustion*. Staged combustion can lower NO_x emissions by 30 to 50 percent. In staged combustion, fuel is burned in two stages at different fuel to air mixtures. In the first stage, so little oxygen exists that nitrogen fails to react with oxygen and is released as molecular nitrogen and carbon monoxide. In the second stage, sufficient oxygen is supplied to burn the carbon particles and convert the carbon monoxide to carbon dioxide.

INFORMATION SHEET #15

Various Technologies Available to Lower Emissions of Sulfur Dioxide

Technology	Description	Status: Current and Projected	Advantages	Disadvantages	Economic Feasibility	Waste Product
Physical Coal Cleaning	• Removes inorganic sulfur by using difference in specific gravity of iron sulfide and coal	• Commercially used • Future limited as emission standards become more stringent	• Can be used in conjunction with FGD to reduce costs • Inexpensive process • Does not normally require boiler modifications	• Only 14 percent of U.S. coals can be cleaned enough to meet NSPS standards • May require large electrostatic precipitator	• Relatively inexpensive but limited in application	• Large quantities of high sulfur refuse/ash
Flue-Gas Desulfurization (FGD)	• Remove SO_2 from combustion gases after burning through absorption in an alkaline solution	• Commercially used • Offers most efficient and economical method of SO_2 control now available on a widespread basis	• Can be retrofitted to existing boilers • Efficient	• Generates large quantities of sulfur-laden sludge	• Provides an effective and efficient means of meeting NSPS emission standards without modifying or replacing existing boilers	• Sludge
Fluidized Bed Combustion (FBC)	• Combustion of pulverized coal in a bed of limestone or dolomite • Fluidized by air, SO_2; absorbed by absorbent (limestone)	• Emerging technology in pilot plant testing • Commercial availability for atmospheric FBC in mid-1980s; in early 1990s for pressurized FBC	• SO_2 removal: 80 to 90 percent • Lower combustor capital costs • Wide fuel flexibility • Lower operating temperatures	• Generates large quantities of spent absorbent • Larger precipitators required	• Appears to have economic advantage over FGD operating and capital costs	• Dry spent sorbent
Coal Liquefaction	• Reaction with hydrogen, heat, and pressure in presence of catalysts or chemical solvents to produce liquid fuels	• Four processes in pilot stage: Direct catalytic hydrogenation, solvent extraction, pyrolysis, and liquid hydrocarbon synthesis • Commercialization: 1990s	• Wide variety of coals • Produces clean burning fuels • SO_2 removal: greater than 95 percent	• Unidentified pollution problems • Potential for toxic by-products • High particulate control needed	• High overall development costs	
Coal Gasification	• Reaction with steam or hydrogen and air/oxygen at high temperature to produce high or low BTU gas	• Low BTU • Commercialization: mid-1980s • Current low BTU • Demonstration (Small-scale industrial) • High BTU • Commercialization: 1990	• Can be used in conventional gas-fired power plants • SO_2 removal: Greater than 95 percent	• Same as liquefaction	• Same as liquefaction	

Adapted from the Environmental Protection Agency

INFORMATION SHEET #16

Control of Motor Vehicle Emissions

In terms of the total quantity of pollutants that are emitted into air in the United States, the primary offender is the motor vehicle. A number of measures are used to control the various pollutants that are produced by different components of the automobile. They are as follows.

1. Positive crankcase ventilation system (PCV) — Reduces hydrocarbon emissions from the crankcase by channeling crankcase blow-by gases back to the engine, where they are burned.

2. Catalytic converters — Catalytic converters chemically change the hydrocarbons and carbon monoxide in exhaust into carbon dioxide and water vapor. However, the device works only when unleaded gasoline is used.

INFORMATION SHEET #17

Air and Health

Air is essential to life on earth. Most cells of the body derive the bulk of their energy from chemical reactions involving oxygen obtained from the environment by breathing. Carbon dioxide plays a vital role in the cellular process. It is a waste product of cellular respiration and it also serves to regulate the rate of breathing. The presence of carbon dioxide in the form of carbonic acid functions to control the acidity-alkalinity balance of the blood. All the major components of air, and some of the minor ones, are of biological importance to people's health.

A common disease attributed to air pollution is *emphysema*. This disease attacks the membranous walls of the alveoli. Alveoli are clusters of tiny cup-shaped hollow sacs, lined with blood capillaries serving as the sites of gas exchange in the lungs. Pollutants cause the thin alveoli walls to lose their elasticity and tear apart. Nonfunctioning air spaces are left. The area in which gas can exchange is restricted. Oxygen deficiency results.

Bronchial asthma and chronic constrictive ventilatory disease, a condition related to emphysema, are also aggravated by air pollution. Some researchers believe there is a link between air pollution and the common cold.

Air pollution is also a contributor to lung cancer.

Sulfur oxides and nitrogen oxides damage human health by causing irritation of the eyes and respiratory passages.

Hydrocarbons are a major constituent of smog. Smog can contribute to mental depression and accidents due to poor visibility.

The inhalation of asbestos fibers has been linked to malignant diseases of the lungs.

INFORMATION SHEET #18

What Can You Do to Improve Air Quality?

Know the law, how it affects both private and corporate citizens. Become familiar with local, state, and federal air pollution control regulations. Comply with provisions that affect individuals, and report violations or what appears to be excessive air pollution to local authorities and to the Illinois Environmental Protection Agency.

When buying a car, obtain detailed information about air pollution control equipment. Compare cars you are considering and buy the one which pollutes least. In general, smaller engines cause less pollution than larger, more powerful ones.

Keep your car well-tuned, and have regular maintenance performed on its pollution control systems.

Use low lead content gasoline.

Drive sparingly. Avoid fast acceleration, high speeds, and excessive idling. Plan your driving to avoid unnecessary trips.

Organize car pools to transport children to school in bad weather, or for driving to jobs.

Use and promote mass transit systems—buses, subways, and trains where available—as the most efficient and economical way to move people with the least harmful effects on the environment.

Campaign for better pollution controls on mass transit vehicles. Support regulations against excessive idling of buses and trucks on city streets.

Support federal or state programs for development of long distance, high speed ground transportation systems.

For the sake of your health, for the sake of the air around you, walk or bike whenever possible.

Work with local city and park officials to have bicycle lanes and scenic routes marked. Urge the closing of specific downtown city streets to vehicle traffic for use as pedestrian malls.

Don't smoke. If you must smoke, refrain from lighting up in public places where others must breathe your smoke. Support smoking restrictions in theaters, hotels, restaurants, public recreation facilities, meeting places, and the like.

Don't burn leaves, trash, or other refuse. Encourage local enforcement of open burning prohibitions. Call your fire department to report trash or leaf fires. Support programs for universal garbage collection.

Request that air pollution control provisions be written into local building construction and demolition codes. Aim at control of airborne dust, smoke, and sprayed materials, particularly asbestos insulation.

Curtail or eliminate use of volatile chemicals or cleaners at home, especially aerosol dispensers. All such products contain propellant chemicals which can be harmful when inhaled.

Reduce your electrical power consumption to place lower demands on pollution-producing generator stations. Turn off unnecessary lights, turn down your thermostat, use your air conditioner as little as possible, turn off radios, TV, and other appliances when not needed.

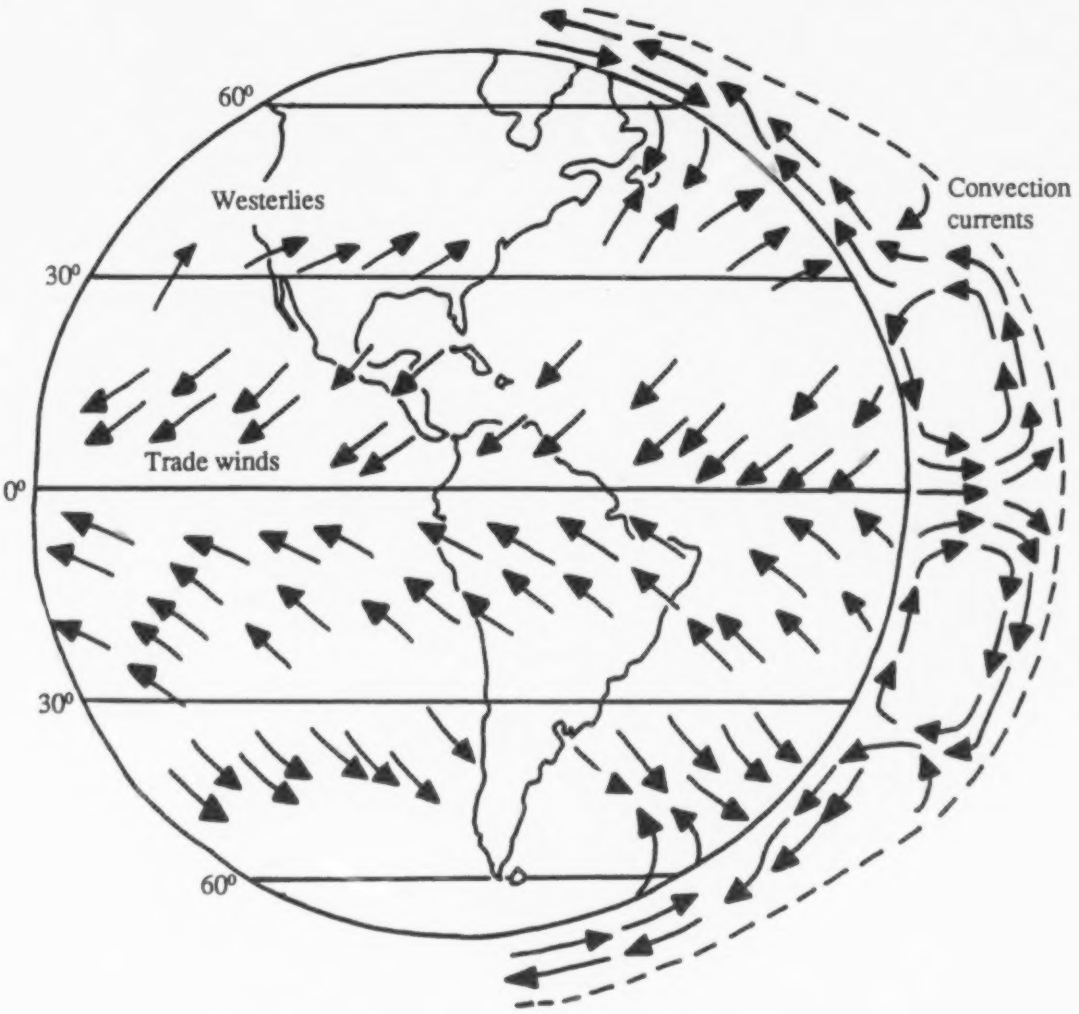
Avoid buying and using luxury power gadgets such as electric knives, can openers, brooms, blankets, vibrators, styling combs, vanity mirrors, scissors, etc.

Use hand-powered lawn and garden tools wherever possible. Electric and gasoline-powered mowers and tools raise the demand on generating facilities and emit polluting fumes.

Plant trees and other vegetation. They produce oxygen and absorb carbon dioxide. They provide wildlife habitat while screening out noise, filtering dust, moderating temperatures, and improving property values. They make your neighborhood environment more relaxed and enjoyable.

TRANSPARENCY MASTER #1

Global Wind Patterns

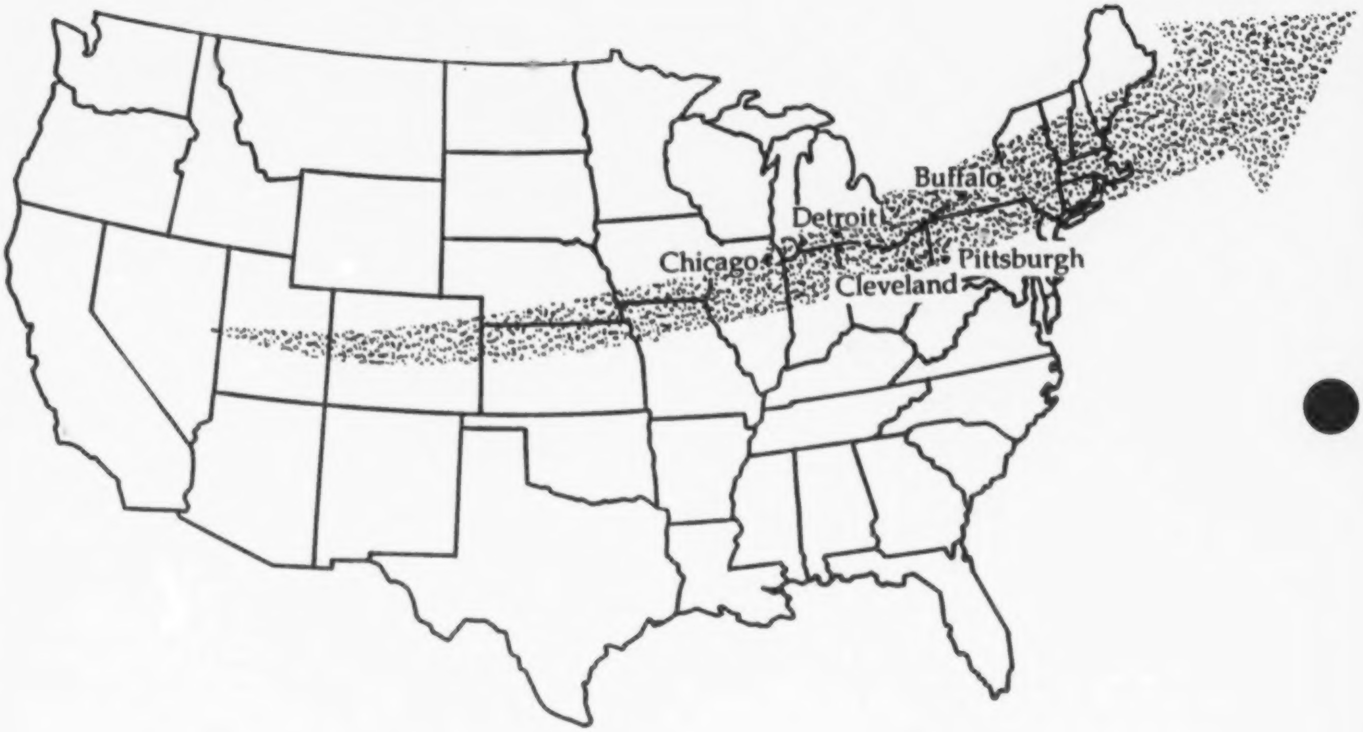

60°
Westerlies
30°
Trade winds
0°
30°
60°
Convection currents

Wind is the movement of air caused by temperature differences and the rotation of the earth. Both of these contribute to the patterns of air movement in the world. In the North American continent, most of our winds are westerlies (from the west to the east).

80

TRANSPARENCY MASTER #2

Accumulation of Pollutants


Buffalo
Detroit
Chicago
Pittsburgh
Cleveland

As an air mass moves across the continent from west to east, each population center adds its pollutants to the air.

TRANSPARENCY MASTER #3

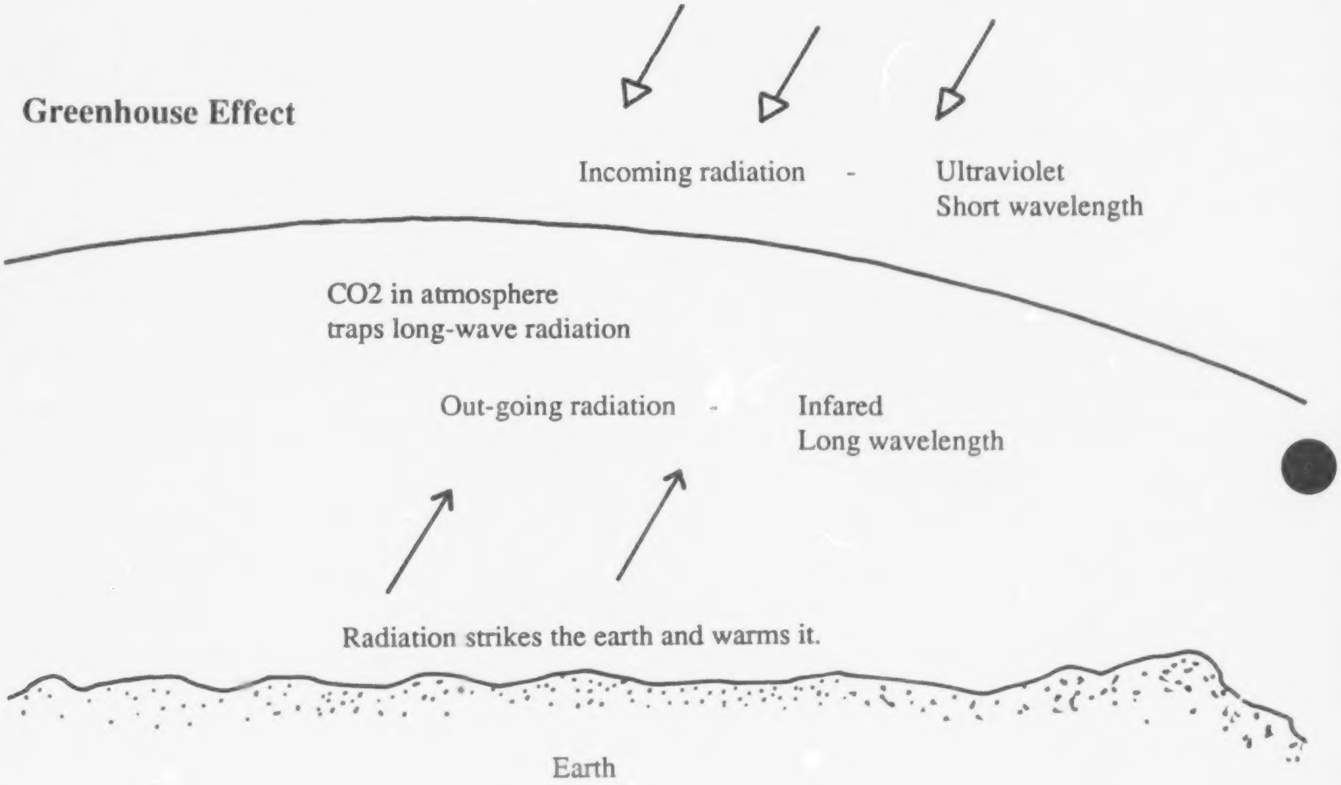
Sources of Air Pollution

(in millions of tons annually)

	Carbon monoxide	Sulphur oxides	Nitrogen oxide	Hydro-carbons	Particulate matter	Totals
Motor vehicles	66	1	6	12	1	86
Industry	2	9	2	4	6	23
Power plants	1	12	3	1	3	20
Space heating	2	3	1	1	1	8
Refuse disposal	1	1	1	1	1	5
Totals	72	26	13	19	12	142

TRANSPARENCY MASTER #4

Greenhouse Effect


Greenhouse Effect
Incoming radiation - Ultraviolet
Short wavelength
CO2 in atmosphere
traps long-wave radiation
Out-going radiation - Infared
Long wavelength
Radiation strikes the earth and warms it.
Earth

TRANSPARENCY MASTER #5

Control Techniques for Indoor Air Quality

Control Measure Description	Pollutant	Example
Air cleaning: Purification of indoor air by gas absorbers, air filters, and electrostatic precipitators	Particulate matter; combustion by-products	Residential air cleaners to control tobacco smoke or wood smoke
Behavioral adjustment: Reduction in human exposure through modification of behavior patterns	Organic substances; combustion by-products; tobacco smoke	Smoke-free zones; architectural design of interior space
Source modification: Reduction of emission rates through changes in design or processes	Organic substances; combustion by-products	Containment of asbestos; design of buildings without basements; catalytic oxidation of CO to CO_2 in kerosene burners
Source removal: Removal of indoor emission sources	Organic substances; asbestiform minerals; tobacco smoke	Restrictions on smoking in public places; removal of asbestos
Ventilation: Dilution of indoor air with fresh outdoor air or recirculated filtered air	Combustion by-products; tobacco smoke; biological agents (particles)	Local exhaust of gas-stove emissions; air-to-air heat exchangers

Adapted from J.D. Spengler and K. Sexton, *Science* 221 (4605):13, 1983.

TRANSPARENCY MASTER #6

Pollutant Standards Index of Air Quality

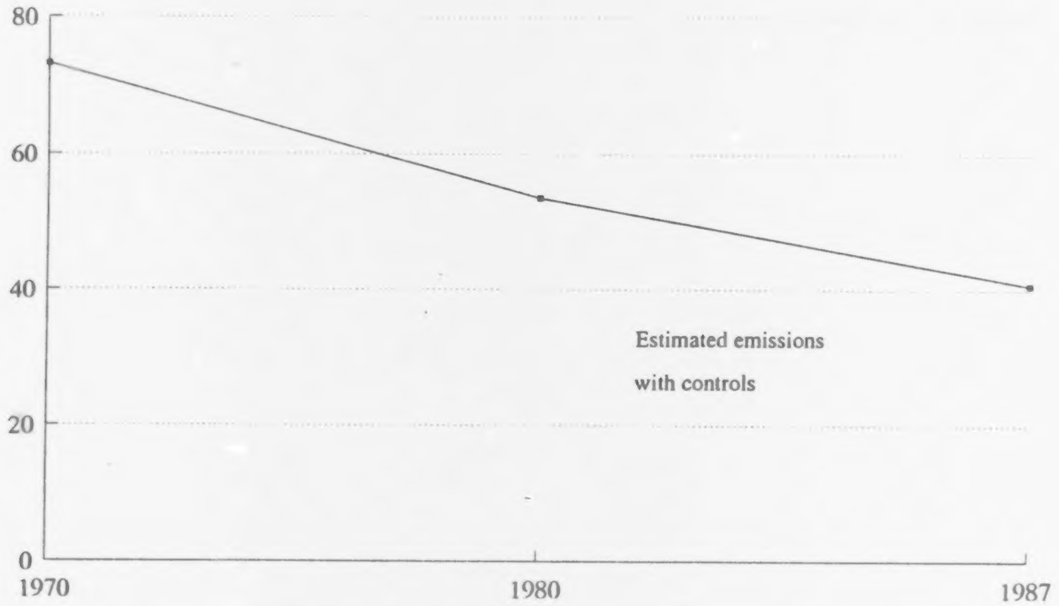
(PSI) Value Statement	Description	Episode Level	General Health Effects	Cautions
0 - 50	Good			
51 - 100	Moderate			
101 - 200	Unhealthful	Primary Standard	Mild aggravation of symptoms in susceptible persons, with irritation symptoms in the healthy population	Persons with existing heart or respiratory ailments should reduce physical exertion and outdoor activity
201 - 300	Very Unhealthful	Alert	Significant aggravation of symptoms and decreased exercise tolerance in persons with heart or lung disease with widespread symptoms in the healthy populations	Elderly persons and those with existing heart or lung disease should stay indoors and reduce physical activity
301 - 400	Hazardous	Warning	Premature onset of certain diseases in addition to significant aggravation of symptoms and decreased exercise tolerance in healthy persons	Elderly persons and those with existing heart or lung diseases should stay indoors and avoid physical exertion; the general population should avoid outdoor activity
401 - Above	Hazardous	Emergency	Premature death of ill and elderly; healthy persons will experience adverse symptoms that affect their normal activity	All persons should remain indoors, keeping windows and doors closed; all persons should minimize physical exertion and avoid traffic

Adapted from the Wisconsin Department of Natural Resources, Bureau of Air Quality Management

85

TRANSPARENCY MASTER #7

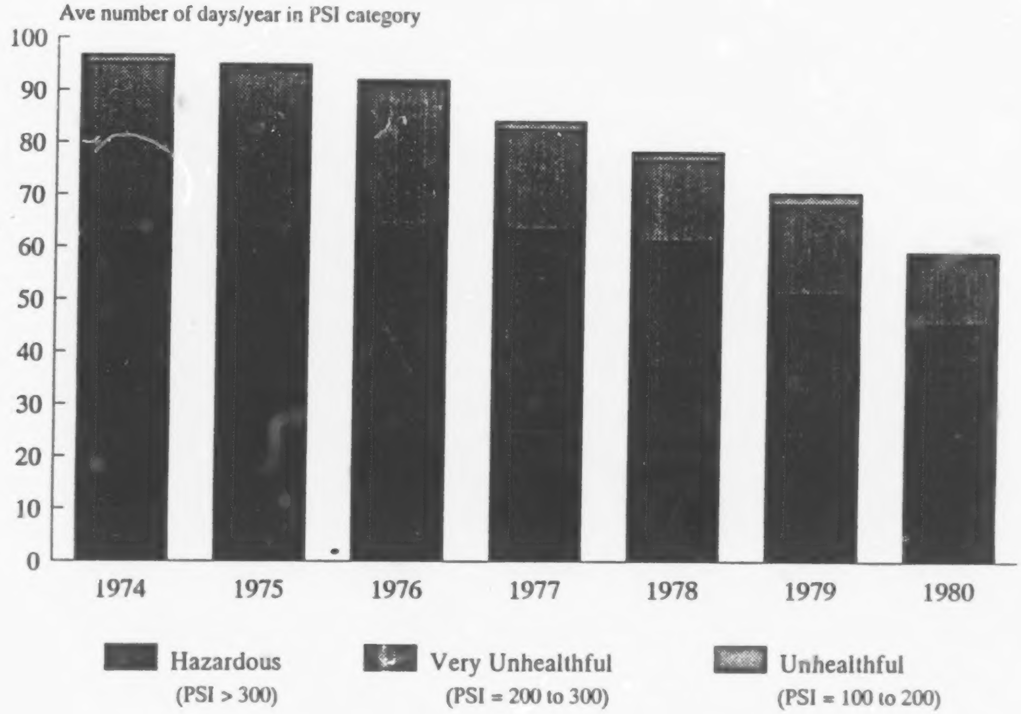
Motor Vehicle Carbon Monoxide Emissions



Motor vehicle carbon monoxide emissions from 1970 through 1987. (From the U.S. Environmental Protection Agency.)

TRANSPARENCY MASTER #8

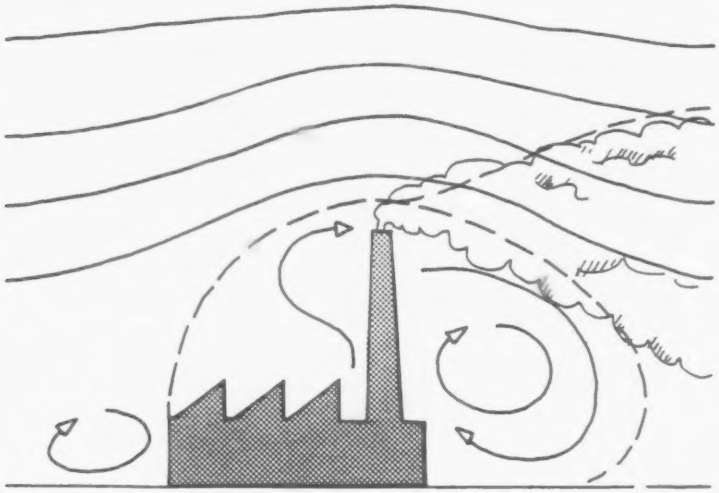
Trend in Pollutant Standards Index in the United States



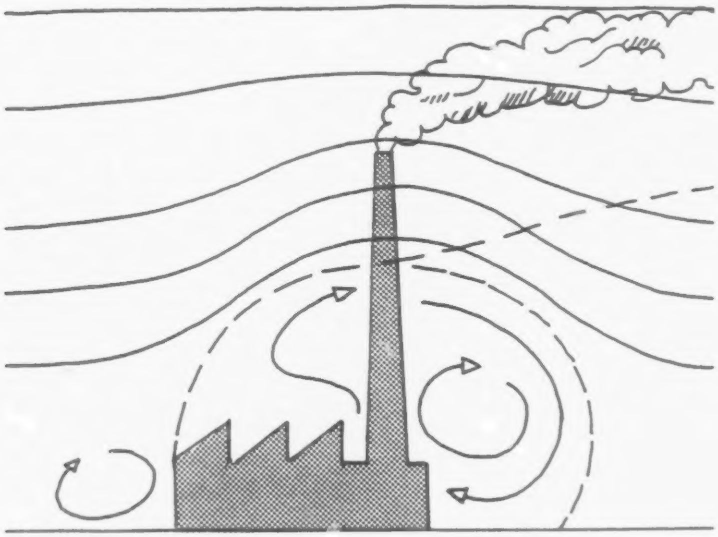
The trend in the Pollutant Standards Index for 23 metropolitan areas in the United States, showing a decline in the frequency of "unhealthy" air-quality days from 1974 through 1980. (From the Council on Environmental Quality.)

TRANSPARENCY MASTER #9

Smokestack Effect



A



B

(a) With low smokestacks, effluents can be trapped within the wake of nearby buildings or of the chimney itself. (b) With smokestacks that are constructed to the height of good engineering practice (2.5 times the height of the nearest obstacle), the effluents clear the wake, preventing downwash.

TRANSPARENCY MASTER #10

Cost and Capability of Various Collectors

Type of control	Cost per actual cu. ft. per minute of treated gas	Percent efficiency
Settling chambers	(Obsolete)	
Wetted baffles	\$.02 to \$.04 [1]	10 - 34
Cyclones collectors	\$.12 to \$.25 [2]	70 - 80
Wet scrubbers	\$.25 to \$1.25 [3]	94 - 96
Electrostatic precipitators	\$.85 to \$1.45 [4]	99+
Fabric filters	\$.75 to \$1.50 [5]	99+

[1] Installed cost per actual cubic feet per minute of gas at collector inlet temperature 1,800 degrees F.

[2] Installation cost, not including such auxiliaries as foundation, supporting steel, flues, and ash removal.

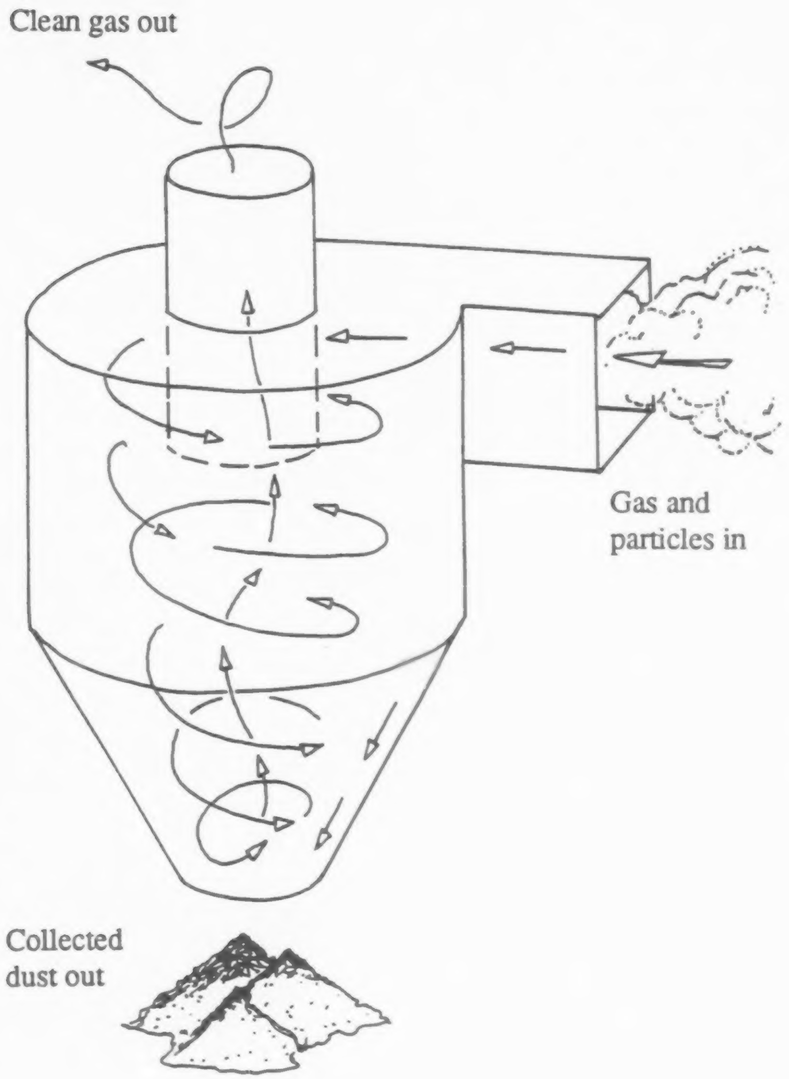
[3] Installed cost for base collector without auxiliaries such as foundation, piping, duct work.

[4] Installed cost not including foundation, flues, fly ash removal.

[5] Based on use of treated fiberglass bags.

TRANSPARENCY MASTER #11

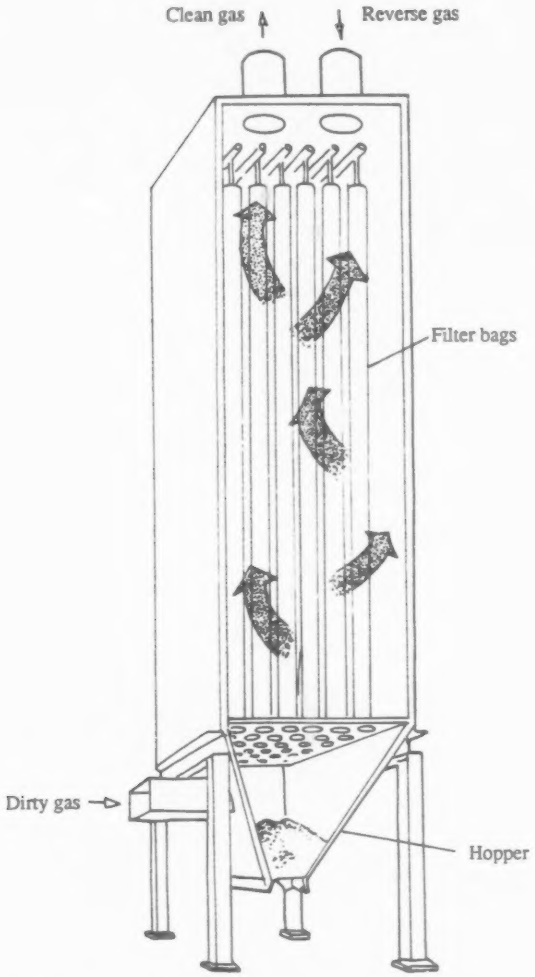
Cyclone Particulate Collector


Clean gas out
Gas and particles in
Collected dust out

A cut-away view of a cyclone particulate collector that removes dust from industrial effluents by inducing gravitational settling

TRANSPARENCY MASTER #12

Industrial Baghouse Compartment for Removal of Particulates

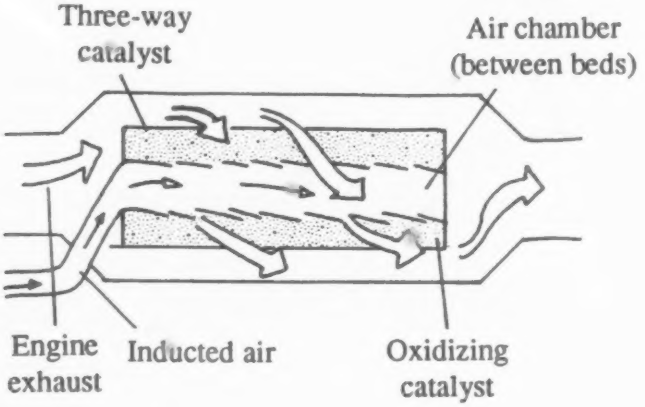


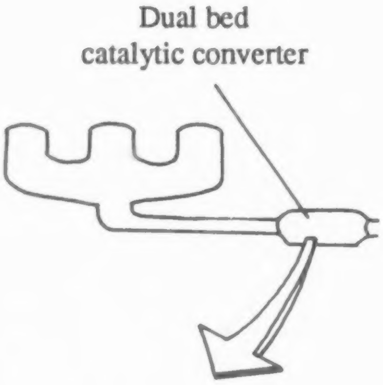
A typical industrial baghouse compartment for removal of particulates. Each bag is up to 35 feet in height and 12 inches in diameter. Accumulated dust is dislodged by some of the filtered gas that is channeled back into the baghouse ("reverse gas"). Dislodged particulates accumulate in the hopper. (Adapted from: EPRI Journal 8 (September):17, 1983.)

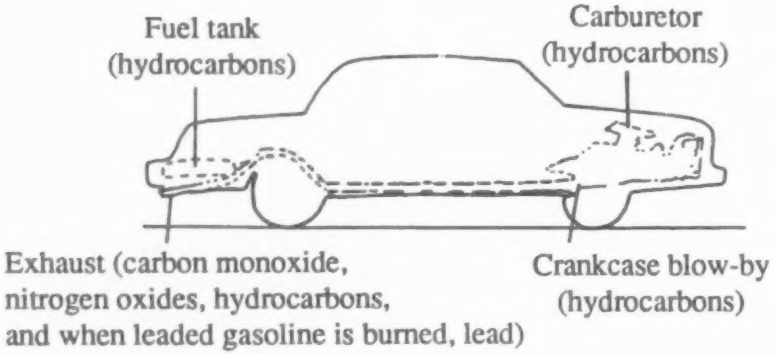
TRANSPARENCY MASTER #13

Catalytic Converter

A catalytic converter chemically changes the hydrocarbons and carbon monoxide in automobile exhaust into carbon dioxide and water vapor. (Adapted: The New York Times, March 15, 1984.


Three-way catalyst
Air chamber (between beds)
Engine exhaust
Inducted air
Oxidizing catalyst


Dual bed catalytic converter


Fuel tank (hydrocarbons)
Carburetor (hydrocarbons)
Exhaust (carbon monoxide, nitrogen oxides, hydrocarbons, and when leaded gasoline is burned, lead)
Crankcase blow-by (hydrocarbons)

Principal sources of air-pollutant emissions in the automobile

STUDENT ACTIVITIES

STUDENT WORKSHEET #1 — Pollution Survey

STUDENT WORKSHEET #2 — Personal Pollution

For additional activities, teachers may refer to the "Suggested Teaching Activities and Procedures" section in the Instructor's Guide.

STUDENT WORKSHEET #1

Pollution Survey

Visit a nearby agricultural industry or local farm. Determine the kind of air pollution produced and the extent of control.

Site visited ______________________________

	Air pollution source	Control measures	Effectiveness of control
1.			
2.			
3.			
4.			
5.			
6.			

What could be done to improve the adequacy of air pollution control at the site you visited?

STUDENT WORKSHEET #2

Personal Pollution

List what you have done during the last week that has contributed to the air pollution problem.

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

What could you do in your daily activities that would improve air quality in your area?

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Environmental Protection

PROBLEM AREA: Understanding Government Regulations and Controls

RELATED PROBLEM AREAS:

1. Conserving Water Resources
2. Controlling Air Pollution
3. Managing Land Resources
4. Managing Freshwater Resources
5. Understanding the Relationship Between Agriculture and the Environment (Central Core Cluster)
6. Preventing Soil Erosion and Managing Land (Agricultural Business and Management Cluster)

PREREQUISITE PROBLEM AREA(S): None

LEVEL: Orientation

OCCUPATIONAL TASKS ADDRESSED:

Agricultural Resources Cluster

Duty A: Managing the Recreational Facility

1. Contribute to annual park management update
2. Assist in development of resource conservation plans

Duty B: Applying Laws, Regulations, and Policies

1. Request visitors to voluntarily comply with rules and regulations
2. Report violations to the appropriate authority
3. Interpret Environmental Protection Agency (EPA) regulations

STATE GOALS FOR LEARNING:

In planning the instruction for this problem area, teachers can promote the development of several student learning objectives which are related to the State Goals for Learning in Biological and Physical Sciences and Social Sciences. These objectives are listed on the Learning Assessment Plan forms included on the following page(s). Those learning objectives marked with an asterisk (*) are taken from the sample lists provided by the Illinois State Board of Education.

CORE

Illinois Agricultural Core Curriculum

Agricultural Education 124 Mumford Hall 1301 W. Gregory Drive University of Illinois Urbana, IL 61801

Director: Dale A. Law, Ed.D.
Principal Investigator: Jerry D. Pepple, Ed.D
Research Assistant: Kevin J. Enderlin

Illinois Agricultural Core Curriculum Rev.

Submission Date ____________
☐ Original submission ☐ Revision

Page ____ of ____

I. LEARNING AREA *(check one)*
☐ Language Arts
☐ Mathematics
☒ Sciences
☐ Fine Arts
☐ Social Sciences
☐ Physical Development/Health

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

(Affix label or complete district information.)

COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐

District Name

City

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will have a working knowledge of the social and environmental implications and limitations of technological development.

Contact Person: ____________
Title: ____________
Phone: (   )

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Evaluate the economic, political, and social implications of scientific and technological developments.					
*2. Recognize that controversy exists concerning controls versus non-controls over the application of technology.					
*3. Evaluate data collected by scientists and others to demonstrate changes in the atmosphere.					
4. Identify the major air pollutants of concern to the IEPA's Division of Air Pollution controls.					
5. Discuss activities of the statewide ambient air quality monitoring network.					
6. Relate agriculture's role in maintaining the goals of the EPA.					
7. Discuss the purpose of resource recovery in Illinois.					

ISBE 41-78 (1/88)

Agricultural Resources
Environmental Protection

Understanding Government Regulations and Controls

Submission Date ____________
☐ Original submission ☐ Revision
Page ____ of ____

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

(Affix label or complete district information.)

COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐

District Name

City

I. LEARNING AREA *(check one)*

☐ Language Arts ☐ Fine Arts
☐ Mathematics ☒ Social Sciences
☐ Sciences ☐ Physical Development/Health

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will be able to demonstrate a knowledge of world geography with emphasis on the United States.

Contact Person: ____________
Title: ____________
Phone: ( )

III. LEARNING OBJECTIVES	IV. ASSESSMENT A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	V. EXPECTATIONS Percent of Students Expected to Achieve Objective
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:					
*1. Understand how decisions affecting the use of the natural environment can have both positive and negative results.					
*2. Understand the role of technology in changing physical and cultural environments.					
*3. Understand the kinds of decisions people must make to determine how to use the natural environment.					
4. Identify the basic strategy used by the Division of Air Pollution Control to control air pollution.					
5. Discuss what is involved in air quality planning.					
6. Discuss how water quality is monitored.					
7. Discuss the purpose of resource recovery in Illinois.					
100					102

ISBE 41-78 (1/88)

Understanding Government Regulations and Controls

Illinois Agricultural Core Curriculum Rev.

Agricultural Resources
Environmental Protection

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Environmental Protection

PROBLEM AREA: Understanding Government Regulations and Controls

STUDENT LEARNING OBJECTIVES

Upon completion of their study of this problem area, students will be able to:

1. Identify the major air pollutants of concern to the Illinois Environmental Protection Agency (IEPA), Division of Air Pollution Control.
2. Identify the basic strategy used by the Division of Air Pollution Control to control air pollution.
3. Discuss the two major functions of the Division of Air Pollution Control field operations staff.
4. Discuss activities of the Statewide Ambient Air Quality Monitoring Network.
5. Discuss what is involved in air quality planning.
6. Identify the importance of the Illinois water supply.
7. Identify the responsibilities of the IEPA Division of Public Water Supply field personnel.
8. Discuss how water quality is monitored.
9. Discuss when water supply permits are required.
10. Discuss the intent of the Resource Conservation and Recovery Act.
11. Identify how landfill sites are selected, operated, and closed.
12. Discuss the purpose of resources recovery in Illinois.
13. Relate agriculture's role in maintaining the goals of the Environmental Protection Agency.
14. Properly react in an environmental emergency.
15. Properly prepare an emergency plan of action for use in an environmental emergency.

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Environmental Protection

PROBLEM AREA: Understanding Government Regulations and Controls

PROBLEMS AND QUESTIONS FOR STUDY

INSTRUCTOR'S NOTES AND REFERENCES

1. What is the purpose of the Illinois Environmental Protection Agency's Division of Air Pollution Control?
2. Is there a strategy for improving Illinois air quality?
3. Should buildings and equipment that emit pollution be required to obtain operating permits from the EPA?
4. What should be involved in air quality planning?
5. What is involved in water quality monitoring?
6. Should water supply personnel be required to have special training and certification?
7. Does Illinois have water quality standards for general-use water?
8. How is water quality in Illinois monitored?
9. What happens if an area becomes too populated for its sewage and water systems?
10. What is the Resource Conservation and Recovery Act?
11. Do Illinois landfills operate under any rules and regulations? If so, what are they?
12. What is agriculture's role in environmental protection?
13. Should planning be done to prepare for an environmental emergency?
14. What should be done in an environmental emergency?

INSTRUCTIONAL RESOURCES

These resources are intended for use by teachers in planning and teaching the materials for this problem area and may be adapted to fit the teaching method(s) used.

INFORMATION SHEET #1 — Illinois Environmental Protection Agency and the Agricultural Community

INFORMATION SHEET #2 — Division of Air Pollution Control

INFORMATION SHEET #3 — Division of Public Water Supply

INFORMATION SHEET #4 — Division of Water Pollution Control

INFORMATION SHEET #5 — Division of Land Pollution Control

INFORMATION SHEET #6 — Environmental Emergencies

INFORMATION SHEET #1

Illinois Environmental Protection Agency and the Agricultural Community

The IEPA has an agriculture advisor who provides technical assistance on agriculture-related matters, coordinates inter-divisional agricultural activities, and serves as the Agency's liaison to agricultural organizations and industries.

Permits Section

The water, air, and land divisions of the IEPA issue permits in agriculture-related situations that correspond with the division's work.

Division of Water Pollution Control
Issues permits for:

Large feed lot operations
Use of municipal sludge on cropland
Facilities to treat agrichemical waste waters

Division of Air Pollution Control
Issues permits for:

Grain handling and grain elevator pollution control facilities
Fertilizer blending operations

Division of Land Pollution Control
Issues permits for and tracks :

Disposal of agrichemical wastes

Office of Emergency Management

The Office of Emergency Management works with the agricultural community responding to such emergencies as chemical spills and fires. The office occasionally coordinates the disposal of unused or unwanted agricultural wastes.

Agricultural Land Preservation Policy

The "Agricultural Land Preservation Policy" recognizes the need to maintain the quality of the state's productive agricultural land, and also to protect this valuable resource from permanent conversion to non-agricultural uses. Subsequently, the General Assembly passed PA 82-945, the Farmland Preservation Act.

Livestock Waste Management

The IEPA has five agricultural specialists assigned as livestock waste management personnel. These people are responsible for investigating problems caused by livestock operations. Investigations of livestock facilities are initiated by:

1. Complaints.
2. Suspicion of a facility's noncompliance with regulations.
3. Random selection.

When an IEPA representative visits a livestock facility, the representative:

1. Informs the facility operator whether or not the facility is in compliance with regulations.
2. Indicates to the operator what the problem is, if compliance is lacking, and offers general recommendations to bring the facility into compliance.
3. Informs the operator that enforcement action will be taken if the problem cannot be resolved voluntarily.

Agrichemical Programs

The extensive use of agricultural chemicals in Illinois requires that the Agency be involved in follow-ups to agrichemical incidents, pesticide waste management, and pesticide monitoring.

Agency field personnel are dispatched to locations where improper handling of pesticides and pesticide-related wastes may be the cause of air, water, or land pollution. The Agency is responsible for investigating such incidents as:

1. Pesticide-related fish kills.
2. Open dumping of pesticide waste materials.
3. Accidental spills.
4. Air pollution from burning pesticide wastes.

Sludge Applications

The recycling and utilization of suitable municipal sludges on land helps to conserve the nutrient, humus, soil, and energy resources of Illinois.

The IEPA is responsible for regulating agricultural uses of municipal sludge and ensuring that land application projects are conducted in an environmentally acceptable manner.

The IEPA has adopted a set of rules for sludge application on land, dealing with transporting, storing, and applying.

INFORMATION SHEET #2

Division of Air Pollution Control

The Illinois Environmental Protection Agency's Division of Air Pollution Control (DAPC) is responsible for implementing and enforcing regulations to assure that the air we breath is clean. The Division's purpose is to find, correct, and control air pollution hazards and prevent them from developing in areas where air quality is good. The IEPA is concerned with many pollutants such as:

1. Sulfur dioxide.
2. Carbon monoxide.
3. Particulates.
4. Nitrogen dioxide.
5. Ozone.
6. Hydrocarbons.
7. Lead.

Air Pollution Control Strategy

The basic strategy in improving air quality is controlling the amount of pollutants emitted by industry and motor vehicles. This strategy involves:

1. Identifying emission sources.
2. Imposing limitations on the amount of emissions in the air.
3. Monitoring the air.
4. Testing the efficiency of the pollution control system along with technological feasibility and economic work.
5. Taking enforcement action against violators of the rules and regulations to bring them into compliance.

Sections of the Air Pollution Control Division

Permits Section

The Permits Section issues the permits which are required in Illinois prior to construction and operation of emission sources and control equipment. The permit program provides a consistent and systematic way of ensuring that air emission sources are built and operated in compliance with air pollution control regulations.

Field Operations Section

The Field Operations Section investigates air pollution sources and works with industry to control emissions at their allowable limit. The three major functions of the Field Operations staff are:

1. To locate and identify air pollution sources and to determine the amount of pollution they emit.
2. To verify the information that industry submits when applying for a permit.
3. To refer possible emission violators for appropriate action.

Field operators perform approximately 3000 investigations a year.

Ambient Air Monitoring Section

The Ambient Air Monitoring Section is responsible for maintaining and operating a statewide air monitoring network. It also supplies technical data for use in:

1. Determining the progress in meeting air quality standards.
2. Activating emergency control procedures during episodes of high pollution levels.
3. Evaluating pollution trends.
4. Evaluating special air quality problems.
5. Preparing special analytical and technical reports.

The network, which operates year round, measures the quality of the air we breathe. The network monitors the air for a variety of pollutants, the most common of which include:

1. Particulate matter.
2. Sulfur dioxide.
3. Ozone.
4. Carbon monoxide.
5. Lead.
6. Nitrogen dioxide.

Air Quality Planning Section

The Air Quality Planning Section reviews all proposed changes in regulations pertaining to air pollution control to identify significant elements of those changes which relate to:

1. Air quality impact.
2. Technological feasibility and socio-economic impact of emission control.

Air quality planning is responsible for:

1. Assuring that Agency programs are adequately designed to achieve and maintain national ambient air quality standards.
2. Preventing deterioration of air quality.

3. Assisting in the development of programs to protect the public from hazardous air pollutants.

4. Conducting and reviewing detailed air quality studies, often using state-of-the-art computerized air quality models.

5. Proposing and supporting regulatory revisions where they are necessary to attain or maintain healthful air quality.

6. Performing ambient air quality impact analyses.

7. Working with local planning efforts to ensure that air quality is protected.

INFORMATION SHEET #3

Division of Public Water Supply

The Environmental Protection Act mandates that "State supervision of public water supplies is necessary in order to protect the pubic from disease and to assure an adequate supply of pure water for all beneficial uses."

Illinois Water Supply

Nearly 200 public water supply systems deliver over 1.77 billion gallons of safe, clean drinking water to Illinois water consumers each day.

The majority of public water supplies (65 percent) pump water from underground wells for treatment and distribution to consumers.

The largest percentage of the population (70 percent) consumes surface water, due to the large number of people in the Chicago metropolitan and suburban areas who receive treated water from Lake Michigan.

Compliance Monitoring / Enforcement

Field personnel are responsible for monitoring our state water supply. Their responsibilities are:

1. To inspect public water supply systems to evaluate their operational performance and conformance with Illinois regulations.
2. To respond to complaints and requests for assistance.
3. To prepare evidence for enforcement cases.

Water Quality Monitoring

Water supplies are required to demonstrate the safe quality of their water through routine sampling programs. Water is tested for:

1. Microbiological
2. Radiological
3. Organic
4. Inorganic

chemical parameters

Public notice must be issued by supplies which fail to meet water quality standards, so that water consumers are aware of the condition of their water.

Water Supply Permits

A construction or operating permit is required to be obtained by:

1. A water supply system constructing a new facility, installing new equipment, or modifying existing equipment.
2. A water supply system putting a newly constructed facility on line.
3. A water supply system undertaking algae control operations.
4. Any plant or enterprise applying pesticides upstream of public water supply intakes.

Water Supply Systems

1. Water supply personnel must demonstrate their competence in the operation of water supply equipment and processes.

2. A properly certified operator must be in charge of the treatment and distribution facilities at all times.

Emergency Response

Division of Public Water Supply personnel assist water supplies in resolving emergencies that threaten the safety or quality of drinking water. Field personnel provide on-site or advisory evaluation of threats such as bacteria, droughts, storms, and hazardous materials spills and contaminations. Immediate response is provided to ensure that public health is protected.

INFORMATION SHEET #4

Division of Water Pollution Control

The 1970 Illinois Environmental Protection Act states that "no persons shall cause or threaten or allow the discharge of any contaminants into the environment . . . as to cause or tend to cause water pollution in Illinois."

The IEPA water pollution program is designed to identify sources of water pollution and implement steps to reduce it and prevent it from continuing.

Water Quality Standards

Illinois has had water quality standards since 1967. The current set of Illinois general use standards regulates 30 different pollutants including arsenic, copper, cyanide, iron, lead, mercury, dissolved oxygen, pH, alkalinity and temperature.

Illinois has nearly 20 standards or limitations that apply to waste water released from industries or municipal sewage systems into rivers, lakes, or streams.

Surveillance and Enforcement

Waste water discharges and the quality of the receiving body of water are monitored to insure that water quality and effluent standards are met.

Water quality is monitored in the following ways:

1. Municipal and industry treatment plants must keep continuous records of discharge characteristics.
2. A network of several hundred sampling stations located on streams throughout the state collects samples on a regular basis.
3. More detailed water quality, sediment, fishery, and habitat data are collected though intensive basin investigations.

When violations are detected through the Division's field and program monitoring activities and corrective action is not taken by the discharge, formal enforcement actions are initiated. The enforcement cases are referred to the Illinois Attorney General's Office for prosecution before the Illinois Pollution Control Board.

Construction Grants

Communities must often install costly wastewater treatment facilities to meet water quality and effluent standards. Both state and federal assistance is available for assistance to local communities.

To allocate funds effectively a priority list is established to rank projects requesting funding. Funding is offered to projects with top priority ratings. At least 700 municipalities are upgrading sewage treatment facilities.

Keeping Pace with Growth

As communities grow, the need for new or extended sewer systems also grows, enhancing the danger of water pollution. The IEPA notifies sewage treatment plant operatives when the plant has reached its capacity and is a potential water pollutant. If corrective action is not taken, the treatment plant will be placed on the restricted status list. This is a list of sewage treatment plants that may not make sewer additions until the plant or portions of the system are remodeled, added to, or otherwise corrected.

Planning

Water pollutants also come from man's activities carried out on land. Polluted waters flow freely when rain washes across the land. Sediment, fertilizers, pesticides, oils, grease, chemicals, and litter from farming construction, mining, and industrial production contribute to water pollution. Growth from an expanding economy and population is also a cause of pollution in our rivers, lakes, and streams. Solutions for this type of pollution are not easy.

The development of a statewide comprehensive water quality management plan consolidated state efforts to further control water pollution from point and nonpoint sources.

INFORMATION SHEET #5

Division of Land Pollution Control

Today's "throwaway society" uses and discards a staggering number of products. Every man, woman, and child in Illinois generates from five to six pounds of solid waste each day.

Industry also contributes to the growing waste problem by increasing production to meet consumer demands. The disposal of these wastes is a serious problem in our state and throughout the country.

In the past, waste products were disposed of in the air, water, and land. Today, regulations restrict the emission, discharge, and disposal of substances into the air, water, and land. These regulations were results of the following acts:

1. Clean Air and Clean Water Acts.
2. Resource Conservation and Recovery Act.
3. Environmental Protection Act.

Resource Conservation and Recovery Act

RCRA is a driving force in solid waste management. The intent of the act is to effect:

1. The control of hazardous wastes.
2. An increase in the opportunities for resource recovery and recycling.
3. A provision for environmentally acceptable disposal of all future wastes.

Selecting Landfill Sites

Senate Bill 172 assigns to counties and municipal governments the responsibility of approving the location of all new pollution control facilities.

The bill explains the process local officials must follow in approving or disapproving regional pollution control facilities such as landfills or incinerators.

Landfill Operation

Geology, hydrology, and aesthetics are among the many important considerations that must be taken into account when evaluating a landfill proposal.

Landfill proposal - Landfill designers must:

1. Submit an engineering plan.
2. Have evidence of local siting approval.
3. Obtain a permit from the IEPA before construction.

Landfill development - Landfill developers must:

1. Obtain an operating permit from the IEPA.
2. Allow inspection by the IEPA to determine if the site has been developed in accordance with approved plans and permit.

Landfill operation - Landfill operators must:

1. Spread, compact, and cover municipal waste with a minimum six-inch layer of earth at the end of each day.
2. Monitor ground water several times a year for signs of pollution.

Closing landfills - Landfill operators must:

1. Grate and seed with at least two feet of compacted earth.
2 Convert the land to serve appropriate use.

Clean Illinois

Clean Illinois is a project targeted for cleanup and protection of abandoned and uncontrolled hazard waste sites in Illinois. Although most of the money allotted to the project is targeted for waste removal and cleanup work at orphan chemical waste sites, the funds are also used for a number of other hazardous waste management and cleanup activities.

This work involves:

1. Identifying new sites that may be eligible for federal superfund or state cleanup assistance.
2. Providing state matching funds to make federal grant monies available for cleanup of superfund sites.
3. Starting fast tract construction for state-funded cleanup projects.
4. Providing contingency funding for emergency response and immediate removal actions.
5. Enhancing the state's ground water protection system.
6. Undertaking chemical safety research to determine the toxicity of hazardous substances.
7. Studying hazardous waste disposal problems and developing alternatives.

110

Resource Recovery

The Solid Waste Management Act is designed to promote the development of alternatives and new technology to handle solid waste and to reduce reliance on land disposal.

Source reduction, recycling, and incineration are a few of the waste management objectives to be met in order for the program to be effective.

To accomplish these goals the state offers:

1. Recycling grants to encourage increased recycling and reuse of waste products.
2. Planning grants and technical assistance to local government to aid solid waste management programs.
3. Research and development to find alternative waste disposal techniques and to develop new industries.
4. Expansion of the Industrial Materials Exchange Service which seeks ways to convert one industry's waste into another industry's raw material.
5. The operation of a pilot recycling program within state government.

INFORMATION SHEET #6

Environmental Emergencies

Whom to Contact

Help in dealing with an environmental emergency involving a hazardous material is as close as the nearest telephone. Such an emergency should be reported to the Illinois Emergency Services and Disaster Agency by calling (217) 782-7896, a 24 hour hotline which functions seven days a week.

This call serves two purposes:

1. It gives the necessary information to activate the appropriate state response personnel.
2. It meets state reporting requirements for such emergencies.

Reporting an Incident

In reporting an incident the caller should provide as much of the following information as possible:

1. Caller's name and/or name of the responsible party.
2. Date, time, and location of the incident.
3. Extent of any injuries.
4. The incident's environmental impact.
5. What material is involved, if known.
6. What personnel are on the scene.
7. What actions are being taken.
8. Telephone call-back numbers.

The primary concern of the State of Illinois in any emergency is protection of public health and safety.

Preparing for Environmental Emergencies

Planning

1. Prepare an emergency contingency plan which includes:
   a. A telephone directory for response personnel with duty and non-duty numbers.
   b. The locations and capabilities of evacuation shelters.
   c. An equipment inventory.
   d. A cleanup contractor list.
   e. Maps and diagrams of the area.
   f. A chemical reference library.
   g. Established communications channels for response.
   h. Material safety data sheets and current working inventory for those chemicals known to be handled at the site.
   i. Maps identifying storage areas, drainage patterns, sewers, water lines, and utilities as well as the location of safety equipment.
   j. A supply of gas detection tubes for air emissions.
   k. The location and inventory of protective clothing.

2. Provide adequate containment - prevention measures such as:
   a. Diking around tanks and transfer points.
   b. Control of floor drains.
   c. Fire suppression systems.
   d. Maintaining a supply of containment/absorbent booms and pads.
   e. Maintaining site security such as lighting, fencing, and separation of combustibles from possible sources of ignition.

3. Conduct simulated response exercises.
4. Verify insurance coverage for response action.
5. Critique response to actual incidents.

Response

1. Secure a Perimeter - A safety zone completely surrounding the hazard must be maintained for the duration of the incident, with no unauthorized or unprotected personnel allowed beyond the boundary.

2. Designate an on-scene coordinator.

3. Establish a Command Post - This should be a predesignated or highly visible site where response personnel and the responsible party can maintain control of the incident.

4. Maintain Communications with the Media - This can be accomplished by designating a media officer, holding press conference, or issuing a press release at established times.

5. Implement Response Actions - Delegate response officials for various duties utilizing the best personnel and equipment on hand to meet these major objectives:
   a. Risk assessment to the public and the environment.
   b. Isolation and containment of the hazard.
   c. Restoration of the affected area.
   d. Disposal or treatment of hazardous material or debris resulting from the emergency.
   e. Termination of the emergency conditions.
   f. Follow-up action for necessary long-term sampling or monitoring programs.

STUDENT ACTIVITIES

STUDENT WORKSHEET #1 — Role Play

For additional activities, teachers may refer to the "Suggested Teaching Activities and Procedures" section in the Instructor's Guide.

STUDENT WORKSHEET #1

Role Play

Situation:

You are fishing at a local stream. You notice a large number of dead fish floating on the water at your favorite fishing hole. You decide to walk upstream to see how severe the problem is. About a mile up stream you find that there are no more dead fish floating on the water. You are near a farm that has a large farrow to finish operation and notice the system used to store manure was leaking heavily and manure was running into the stream.

Answer the following set of questions given the information above:

1. If put in this situation what should you do? (List the step-by-step actions you would take.)

2. Should the farmer be prosecuted for allowing the waste to spill into the creek? Why or why not?

3. If the farmer was found to be at fault, should the farmer be held responsible for the costs of cleaning up the creek?

4. As a member of the community, how would you feel towards the farmer as a result of the environmental emergency?

5. Three months after cleanup was completed the farmer allowed another spill to occur. Should the state shut down the farmer's swine operation?

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Environmental Protection

PROBLEM AREA: Managing Land Resources

RELATED PROBLEM AREAS:

1. Conserving Water Resources
2. Controlling Air Pollution
3. Managing Forestry Resources
4. Managing Game Preserves
5. Managing Parks and Recreational Areas
6. Surveying, Grading and Tiling (Horticulture Cluster)
7. Preventing Soil Erosion and Managing Land (Agricultural Business and Management Cluster)

PREREQUISITE PROBLEM AREA(S):

1. Recognizing the Role of Agriculture in Society (Central Core Cluster)
2. Understanding the Relationship Between Agriculture and the Environment (Central Core Cluster)

LEVEL: Orientation

OCCUPATIONAL TASKS ADDRESSED:

Agricultural Resources Cluster

Duty A: Managing the Recreational Facility

1. Determine land use capability
2. Assist in development of resource conservation plans
3. Interpret maps, charts and aerial photographs

Duty B: Applying Laws, Regulations and Policies

1. Interpret stream, lake, pond, and groundwater laws

Duty G: Assembling, Servicing and Maintaining Equipment and Facilities

1. Follow a facility and grounds maintenance schedule
2. Report facility and grounds maintenance needs
3. Maintain grounds and recreational areas
4. Perform preventative and scheduled maintenance activities on grounds and facilities

STATE GOALS FOR LEARNING

In planning the instruction for this problem area, teachers can promote the development of several student learning objectives which are related to the State Goals for Learning in Biological and Physical Sciences and Social Sciences. These objectives are listed on the Learning Assessment Plan forms included on the following page(s). Those learning objectives marked with an asterisk (*) are taken from the sample lists provided by the Illinois State Board of Education.

Illinois Agricultural Core Curriculum
Agricultural Education 124 Mumford Hall 1301 W. Gregory Drive University of Illinois Urbana, IL 61801

Director: Dale A. Law, Ed.D.
Principal Investigator: Jerry D. Pepple, Ed.D
Research Assistant: Kevin J. Enderlin

Submission Date ____________
☐ Original submission ☐ Revision
Page ____ of ____

I. LEARNING AREA *(check one)*
☐ Language Arts ☐ Fine Arts
☐ Mathematics ☐ Social Sciences
☒ Sciences ☐ Physical Development/Health

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

(Affix label or complete district information.)
COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐
District Name
City

Contact Person: ____________
Title: ____________
Phone: (   )

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will have a working knowledge of the social and environmental implications and limitations of technological development.

III. LEARNING OBJECTIVES

By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:

	IV. ASSESSMENT				V. EXPECTATIONS
	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Understand the impact of technological developments on society.					
*2. Develop an environmental impact statement for a local project.					
*3. Recognize the variety of Illinois' natural areas and relate them to economics and recreation.					
4. Identify how our growing population and expanding urban areas have created land-use problems in the United States.					
5. Identify the land-use management practices utilized on national forests and national resource lands.					
6. Discuss the problems associated with unplanned urban growth.					
7. List and describe the natural hazards which cause land development to be severely limited.					

ISBE 41-78 (1/88)

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

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Submission Date ____________
☐ Original submission ☐ Revision
Page ____ of ____

I. LEARNING AREA *(check one)*
☐ Language Arts ☐ Fine Arts
☐ Mathematics ☒ Social Sciences
☐ Sciences ☐ Physical Development/Health

(Affix label or complete district information.)
COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐
District Name
City

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will be able to understand and analyze comparative political and economic systems with an emphasis on the political and economic systems of the United States.

Contact Person: ____________
Title: ____________
Phone: ( )

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Evaluate the economic impact of political decisions made by federal, state, and local governments.					
*2. Analyze the principal elements in the concept of scarcity including unlimited wants, limited resources, and opportunity costs.					
3. Discuss how the improper use of our land resources led to the establishment of public lands in the United States.					
4. Identify the land-use management practices utilized on national forests and national resource lands.					
5. Discuss the detrimental effects of surface mining.					
6. Identify and describe the three types of urban development.					
119					120

ISBE 41-78 (1/88)

Illinois Agricultural Core Curriculum Rev.

Managing Land Resources

4

Agricultural Resources
Environmental Protection

Submission Date ____________________

☐ Original submission ☐ Revision

Page ____ of ____

I. LEARNING AREA *(check one)*

☐ Language Arts
☐ Mathematics
☐ Sciences
☐ Fine Arts
☒ Social Sciences
☐ Physical Development/Health

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

(Affix label or complete district information.)

COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐

District Name

City

Contact Person: ____________________

Title: ____________________

Phone: (   )

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will be able to demonstrate a knowledge of world geography with emphasis on the United States.

By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:

III. LEARNING OBJECTIVES	IV. ASSESSMENT A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	V. EXPECTATIONS Percent of Students Expected to Achieve Objective
*1. Analyze the influence of site features and locational factors on land use.					
*2. Know the reasons for different kinds of land use.					
*3. Understand the kinds of decisions people must make to determine how to use the natural environment.					
4. Identify how our growing population and expanding urbana areas have created land-use problems in the United States.					
5. Discuss how the improper use of our land resources led to the establishment of public lands in the United States.					
6. Discuss the detrimental effects of surface mining.					
7. Identify the problems associated with the development of flood plains and wetlands.					

ILLINOIS STATE BOARD OF EDUCATION
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LEARNING ASSESSMENT PLAN

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Submission Date ____________________
☐ Original submission ☐ Revision
Page ____ of ____

I. LEARNING AREA *(check one)*
☐ Language Arts ☐ Fine Arts
☐ Mathematics ☒ Social Sciences
☐ Sciences ☐ Physical Development/Health

(Affix label or complete district information.)
COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐
District Name
City

Contact Person: ____________________
Title: ____________________
Phone: (   )

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will be able to apply the skills and knowledge gained in the social sciences to decision making in life situations.

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Compare the economic interdependence among agriculture, business, government, labor, and the consumer.					
*2. Understand the knowledge and skills required for success in selected fields of work.					
*3. Recognize that competence in a field of work entails the development of a wide range of skills.					
4. Discuss the problems associated with unplanned urban growth.					
5. Identify the problems associated with the development of flood plains and wetlands.					
6. Identify the land-use management practices utilized on national forests and national resource lands.					

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Environmental Protection

PROBLEM AREA: Managing Land Resources

STUDENT LEARNING OBJECTIVES

Upon completion of their study of this problem area, students will be able to:

1. Identify how our growing population and expanding urban areas have created land-use problems in the United States.
2. Discuss how the improper use of our land resources led to the establishment of public lands in the United States.
3. Describe correctly the two general categories of public lands.
4. Identify the land-use management practices utilized on national forests and national resource lands.
5. Discuss the detrimental effects of surface mining.
6. Identify the number of surface-mined acres needing reclamation and discuss how reclamation practices can be improved.
7. Identify where early American cities were located and why.
8. Discuss the reasons for increases in population and urbanization during the early 1900s.
9. Identify reasons for urban growth from the inner city to the development of suburbs.
10. Identify and describe the three types of urban development.
11. Discuss the problems associated with unplanned urban growth.
12. Identify the problems associated with the development of food plains and wetlands.
13. Identify the importance of land-use planning and the two major implementation measures.
14. Discuss the importance of urban transportation planning in land-use management.
15. Identify the trend of mass transportation in American urban areas.
16. List and describe the natural hazards which cause land development to be severely limited.
17. Discuss future problems associated with land-use management.

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Environmental Protection

PROBLEM AREA: Managing Land Resources

PROBLEMS AND QUESTIONS FOR STUDY

1. How has our growing population and trend toward urbanization affected land use in the United States?
2. What were the reasons for the establishment of public lands in the United States?
3. What are the basic types of public lands?
4. Who is responsible for the management of public lands in the United States?
5. How does surface mining affect land use?
6. What is land reclamation?
7. How can surface mine land reclamation be improved?
8. What were the reasons for the location of the first American cities?
9. What are the reasons for a trend toward urbanization?
10. Why do suburbs spring up on the edges of metropolitan areas?
11. What are the three types of urban development?
12. What problems are caused by unplanned urban growth?
13. Why shouldn't flood plains and wetlands be developed?
14. What are some ways in which land-use plans can be implemented?
15. How does transportation effect land use?
16. How can urban mass transit reduce land utilized for roadways?
17. What natural hazards could affect land use and development?
18. What future problems do you see in the land-use area?

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Environmental Protection

PROBLEM AREA: Managing Land Resources

SUGGESTED TEACHING ACTIVITIES AND PROCEDURES

1. Obtain a map of your local town or city. Assign each student a parcel of land on the edge of town. Have the students prepare development plans for their parcels of land. Discuss plans in class.
2. Identify the wetlands and flood plains in your area. Discuss the possible uses for that land.
3. Interview residents of your local town or city. Discuss with them why they prefer urban over rural living.
4. Do some research to find out why your local town or community was built where it was.
5. Look at the transportation system in your community. Is it as efficient as you would like to see it? How could it be improved?
6. Invite a local public official from your town or city to speak to the class. Discuss the land-use plan for your urban area.
7. Invite officials from the Soil Conservation Service and the Agricultural Stabilization and Conservation Service to make presentations to the class on their regulations and programs that affect land use in general and wetlands in particular.
8. Invite grain and livestock producers that border your community to address the class on the effect of urban growth on their operation.
9. Visit local public lands and arrange for a presentation by the governing body of those lands on the establishment of the area and the goals of the land.
10. Use the attached State of Illinois publication "Earthquakes in the Illinois Area" as a student reference and as a resource for class discussions relative to your area.

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Environmental Protection

PROBLEM AREA: Managing Land Resources

REFERENCES

1. *Introduction to Environmental Science.* Morgan, Morgan, Wiersma. W.H. Freeman and Company, 4419 West 1980 S., Salt Lake City, UT 84104. (801) 973-4660.

2. *Environmental Science. The Study of Interrelationships.* Enger, Kormelink, Smith, Smith. Wm. C. Brown Publishers, 2460 Kerper Boulevard, Dubuque, IA 52001.

3. *Forests and Forestry.* Holland, Rolfe, Anderson. Interstate Publishers, Inc., P.O. Box 50, Danville, IL 61834-0050. (217)446-0500.

*Indicates highly recommended reference

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTIONAL RESOURCES

These resources are intended for use by teachers in planning and teaching the materials for this problem area and may be adapted to fit the teaching method(s) used.

INFORMATION SHEET #1 — The Problem

INFORMATION SHEET #2 — Public Lands

INFORMATION SHEET #3 — Surface Mine Reclamation

INFORMATION SHEET #4 — American Cities

INFORMATION SHEET #5 — Land Use and Planning

INFORMATION SHEET #6 — Natural Hazards

INFORMATION SHEET #7 — The Future

TRANSPARENCY MASTER #1 — Parks, Wildlife Areas, and Wilderness in the United States

TRANSPARENCY MASTER #2 — Water and Urban Centers

TRANSPARENCY MASTER #3 — Development of Lands in the United States as of 1980

TRANSPARENCY MASTER #4 — Land Use in the United States

TRANSPARENCY MASTER #5 — Rural to Urban Population Shift

TRANSPARENCY MASTER #6 — Twenty-Nine Supercities

TRANSPARENCY MASTER #7 — Loss of Farmland

TRANSPARENCY MASTER #8 — Mass Transportation

TRANSPARENCY MASTER #9 — World's Most Disastrous Earthquakes

TRANSPARENCY MASTER #10 — Zones of Earthquake Risk in the United States

TRANSPARENCY MASTER #11 — Landslide Potential in the United States

INFORMATION SHEET #1

The Problem

We are constantly changing the land by modifying it and reshaping it for housing sites and industrial and commercial purposes. We terrace hillsides; drain and fill in wetlands; cover the ground with concrete, asphalt, and water that is impounded by dams; and whittle out campsites and playgrounds. We grow our food and fiber on land and we build cities on it. In addition, we tear up the land, and extract its rock, mineral, and fuel resources. We also use it as a dumping ground for our wastes.

We have carried out those activities over the years because our population and its demands have continued to grow. But the land and its resources will someday run out. Already, many conflicts have occurred in terms of the way we use our land. Prime farmland is being gobbled up by urbanization and flooded by dams. Our search for living space has prompted many persons to build in regions that are prone to flooding, earthquakes and other natural hazards.

INFORMATION SHEET #2

Public Lands

History

During the first 100 years of our nation's history, our natural resources were exploited without any restrictions. During those years, the government handed over enormous parcels of land to anyone who was willing to exploit its minerals, timber, or water. As a result, rapid economic development occurred as well as extensive environmental damage. Late in the 19th century, it became apparent that relentless development of the land was ruining the environment. The practice of resource conservation was pushed.

1872 — The federal government founded Yellowstone National Park to preserve a part of our natural resources.

1872 — California took steps to protect Yosemite Valley.

1892 — First federal forest reserves were set aside.

1900 — Six national parks were established.

1908 — A 50-member National Conservation Commission was formed at the federal level by President Theodore Roosevelt.

1960 — Congress acted to safeguard our nation's wilderness lands.

1980 — Alaska National Interests Lands Conservation Act was passed by congress. This act more than doubled the acreage of federally protected lands.

Today, public lands under federal management total almost 800 million acres. This is approximately three acres per citizen. More than half of Idaho, Oregon, Nevada, and Utah and more than 75 percent of Alaska are comprised of public land.

Categories of Public Lands

Based on use, public lands fall into two very general categories.

1. Regions that are set aside for the primary purpose of preservation.
2. Areas that are intended for regulated multiple use. Wilderness areas, wild and scenic rivers, national parks, and wildlife refuges are designed primarily to protect and preserve invaluable natural resources. These areas are usually subject to regulations that are intended to prevent multiple uses from interfering with one another and to ensure that the uses of those areas are compatible with environmental quality. Additionally, some federal lands are used for military installations or Indian reservations.

National Forests

National forests were established primarily to foster both a sustained yield of timber and watershed protection as a result of careful management. National forests are also used for the grazing of domestic cattle and sheep, recreation, mining, and preserving fish and wildlife.

Although the concept of multiple use has considerable appeal, we have seen that there are many practical management problems. Managing for high timber yield may conflict with wildlife management aims. As national needs for one particular resource rise, the demand to exploit that resource further will make it more difficult to successfully manage the other resources that exist on public lands. Such conflicts are inevitable in the future and require that citizens keep well informed on the resource-management priorities of public lands.

National Resource Lands

Regulations of land use are not always as strict on the nation's vast national resource lands as on other public lands. These lands, which are scattered throughout the nation and comprise 40 percent of the total public lands, have been used mainly for grazing and mining under the relaxed management of the Bureau of Land Management.

Many of these lands have deteriorated considerably because of over-grazing and damage to ground covers by motorcycles and dune buggies. In 1976 congress passed the Federal Land Policy and Management Act. This act strengthened the Bureau's authority in protecting and managing national resource lands for multiple use.

INFORMATION SHEET #3

Surface Mine Reclamation

Surface mining in the United States has disturbed 5.7 million acres of land. About two-thirds of that land (3,821,573 acres) is in need of reclamation. The remaining 1,898,203 acres, classified as not requiring reclamation, has been treated, primarily through seeding. A relatively small percentage of mined land has been restored to its original productivity level.

Effects of Surface Mining

The Good — Mining affects everyone. Basic minerals, including metals and fuels are the product of surface mining. North America's economic and social well-being rests on a mineral and fossil fuel foundation.

The Bad — Surface mining can adversely affect the quality of land, water, and air, as well as animal and plant life. Depending on the nature of the mining operations and reclamation practices in an area, use of the land after mining can be severely limited.

Overcoming Detrimental Effects

As the area disturbed by surface mining and the demand for land increase, the need to reclaim mined land increases. With this increase comes the further need to develop and apply new technologies. And soon thereafter comes the need to regulate. In a competitive market it is not fair or economically feasible for one mine operator to invest heavily in reclamation while others do not.

The following principles and actions should be considered when making policies and regulations concerning surface mining.

1. Encourage research and development in land reclamation technology.
2. Encourage better planning before mining.
3. Encourage reclamation techniques that provide the greatest choice of alternative land uses.
4. Encourage government agencies to work together.
5. Encourage an economically sound and stable mining industry.
6. Encourage conservation and recycling of existing minerals.
7. Encourage legislatures to keep reclamation laws current.
8. Encourage local input into mine planning and land-use decisions.

INFORMATION SHEET #4

American Cities

History

In the past, land was considered a limitless resource. As the population grew and the demand for food, lodging, and transportation increased, we began to realize that land was a nonrenewable resource.

Land development during the last two decades has destroyed many natural areas that people have long enjoyed. The use of land in the United States is varied.

Urban and transportation	3%
Wildlife refuges, parks	5%
Desert, swamps, tundra	12%
Ungrazed forest lands	23%
Crop land	15%
Idle crop land	2%
Pasture and rangeland	40%

Early American towns were usually built near water, without which these cities would not have developed. Water met many of the primary needs of villages and small towns such as drinking, transportation, power, waste disposal, and, as the cities grew, industry.

North America remained essentially rural until industrial growth began in the last third of the 1800s. During this period, the population began to shift from rural to urban areas. This large-scale migration to the cities had several causes:

1. Improvements in agriculture required less farm labor.

2. Job opportunities were available in the city because industry was developing.

From 1900 to 1910, the population of the United States increased by 16 million, primarily due to new immigrants, three-fourths of whom settled in towns or cities. As the population of the city grew, there was an increased demand for land within the city. As city land prices rose, people and businesses began to look for cheaper land on the outskirts of the city. Real estate agents were quick to assist in development of agricultural land into residential or commercial areas. As long as money could be made by converting agricultural land to other purposes, it was impossible to prevent this conversion.

The Rise of Suburbia

As cities continued to grow, certain sections within each city began to deteriorate. Industrial activity continued to be concentrated near water in the center of the city. Industrial pollution and urban crowding turned the core of many cities into undesirable living areas. In the early 1900s, people who could afford to do so, began to move to the outskirts of the city. Most of the homes were in the attractive suburbs, away from the pollution and congestion of the central city.

In some areas throughout North America, the growth of suburbs has been slowed due to the increased cost of housing and transportation. There has been a migration back to the cities on a limited scale, primarily due to the lower cost of urban housing and the generally more efficient public transportation of the cities than the suburbs.

The Urban Sprawl

By 1960, unplanned suburban growth had become known as the urban sprawl. Large housing tracts surrounded cities, which made it difficult for people to find open space. A city dweller could no longer take a bus to the city limits and enjoy the open space of the countryside.

Urban sprawl occurs in three different ways:

1. One type of growth is associated with the wealthier urbanites adjacent to the city. These subdivisions of homes are on large individual lots in the more pleasing geographical areas.

2. Ribbon sprawl — involves development along transportation routes, usually consisting of commercial and industrial building. Ribbon sprawl involves high costs for the extensions of utilities and other public services. It also makes the extent of urbanization seem much larger than it actually is.

3. Tract development — consists of the construction of similar residential units over large areas, which initially are often separated by farmland.

As suburbs continue to grow, cities once separated by farmland begin to merge. It is difficult to tell where one city ends and the other begins. This type of growth has led to the development of regional cities. Although these cities maintain their individual names, they are really just part of one large urban area. Each of these large regional urban centers is called a megalopolis.

Problems with Unplanned Urban Growth

One United States Department of Agriculture study found that three-fourths of the land recently urbanized was previously used for high-value crop production. An area that is flat, well drained, accessible to transportation, and close to cities is ideal farmland; however, it is also prime development land. Land adjacent to cities that once supported crops now supports new housing developments, shopping centers, and parking lots. The development of farmland is proceeding at a rapid pace in the United States. Approximately one million hectares of land is developed each year. This is equivalent to an area half the size of New Jersey.

Farmland is valuable to the urban dweller for its open space. Open space within urban areas breaks up the sights and sounds of the city and provides a place for many kinds of recreation. Because of inadequate land-use planning, the open spaces in or near urban areas are rapidly being converted to other uses.

Until recently, the creation of a new park within a city was considered to be uneconomical use of the land. Attitudes are slow to change, and people are only now beginning to realize the need for parks and open spaces.

Some cities have recognized the need for open space and allocated land for parks. New York City set aside approximately 200 hectares for central park in the late 1800s. Boston developed a park system that provides a variety of urban open space. However, other cities have not dealt with the need for open space.

INFORMATION SHEET #5

Land Use and Planning

Improper Use of Flood Plains and Wetlands

Floodplains

Many cities are located near rivers in areas called floodplains. A floodplain is the low land on either side of a river and is periodically covered with water. Some areas are flooded every year, and other higher areas may flood less regularly. The best use of these areas may be for open space or recreation.

There is no evidence to support the premise that floods are worse today than they were 100 or 200 years ago, except on small, localized watersheds. What has increased is the economic loss from floods. This loss reflects the fact that cities have been built on floodplains, and also that industries, railroads, and highways have been constructed on floodplains. Sometimes there were no alternatives, but often risks have been ignored. When construction occurs on floodplains, our tax monies are used to repair the damage that results from the unwise use of these areas.

Floodplain Zoning Ordinances

Many communities have enacted floodplain zoning ordinances to restrict future building in floodplains. These ordinances prevent further economic losses from flooding, but do not prevent losses to those individuals who already live in floodplains. Floodplain building ordinances usually allow current residents to remain.

Wetlands

Wetlands are also areas that are frequently misused. Swamps, tidal marshes, and coastal wetlands provide habitats for many diverse species of wildlife. The coastal areas adjacent to large bodies of water are extremely important as fish spawning areas. Most wetlands receive constant inputs of nutrients from the water that drains from the surrounding land. This land is highly productive and the surrounding wetlands are an excellent place for the rapid growth of aquatic species. Human impact on the coastal environment has severely degraded or eliminated these spawning and nursery habitats.

Besides providing necessary habitat for fish, wetlands also provide natural filters for sediments and runoff. This natural filtration process protects water quality. In addition wetlands protect shorelines from erosion. Often when wetlands are destroyed, costly artificial measures such as break waters are built to protect the shoreline.

Wetlands also breed mosquitos, may smell unpleasant, and are barriers to urban growth; therefore, they are often drained or filled. The pressure to destroy these natural areas is greatest where there is a large population. Because these lands have long been thought to be useless, it is easy to see why they are filled or drained. In the past, many cities have used these sites for landfills.

Land-Use Planning

Land-use planning is the construction of an orderly list of priorities for the use of available land. The first step in a land-use plan is to gather data. Data is gathered on current land use, geological information, biological information, and sociological information. From these data, projections are made about what human needs will be. All of the data collected are integrated with human needs projections, and each parcel of land is evaluated and assigned a best use under the circumstances. There are two ways in which these plans can be implemented.

1. Purchasing - Purchasing is probably the simplest way to insure protection of desirable lands. This method has often been used by the government or by conservation-minded organizations or individuals. The major problem with purchasing land is the cost. Many communities are not in the financial position to purchase lands.

2. Zoning - Zoning is a common type of land regulation. When land is zoned, it is designated for specific potential uses. Several common designations are agricultural, commercial, residential, recreational, and industrial. Often local governments lack the funds to hire professional planners. As a result, zoning regulations are frequently made by people who see only the short-term gain and not the possible long-term loss.

Urban Transportation Planning

The development of comprehensive urban transportation plans is of growing concern of urban governments. Urban transportation planning usually involves four major goals.

1. Conserve energy and land resources.

2. Provide efficient and inexpensive transportation within the city for elderly, young, poor, and handicapped.

3. Provide suburban people with opportunity to commute efficiently.

4. Help to reduce urban pollution.

In order for an urban transportation plan to be successful, it should integrate all of these goals. In order to accomplish this, adequate levels of funding and intergovernmental cooperation are needed. Normally, both these factors are limited in the United States. The problems associated with current urban transportation will not disappear overnight, but comprehensive planning is the first step to help solve problems.

A primary method of transportation in most urban centers is the automobile. The automobile has advantages such as convenience and freedom of movement. Many urban areas are beginning to recognize that the disadvantages of the automobile may outweigh the advantages. The disadvantages of urban automobile transportation include air pollution, the use of substantial amounts of land for highways and parking areas, and the encouragement of urban sprawl. Recognizing these disadvantages, some cities have tried to discourage automobile use by developing mass transit systems.

The major types of mass transit systems are railroads, subways, trolleys, and buses. Such systems are not without their own problems, however. The major problems associated with mass transit are that it is:

1. Economically feasible only along heavily populated routes.

2. Less convenient than the automobile.

3. Extremely expensive to build and operate.

4. Often crowded and uncomfortable.

Although mass transit provides for a substantial portion of urban transportation in some parts of the world, mass transit in the United States has continued to decline since the 1940s. A variety of forces has caused this decline. As people become more affluent, they can afford to own automobiles. Government encourages the use of automobiles by financing highways and expressways.

Rising gas prices and increasing competition for parking will prompt more Americans to seek alternatives to private automobile use. Car and van pools and dial a ride services have been accepted by many individuals. Other types of transportation such as the bicycle and motorcycle, should not be overlooked in urban transportation planning.

INFORMATION SHEET #6

Natural Hazards

Some lands are severely limited in their use because of natural hazards. Comprehensive land-use policies also regulate the habitation of those areas to minimize the risk of life, limb, and property. Such policies must be determined with an understanding of the geological characteristics of the area in question and the potential hazards that are created by those characteristics.

Flood Hazard

Floods have caused more damage in our country than any other type of natural hazard. The damage caused by flooding is increasing because of increasing numbers of persons living in floodplains. The fertile soils and plentiful water for irrigation have always been attractive to some persons. Today, many cities in the United States are built almost entirely on floodplains. Approximately 15 percent of the nation's total urban land and almost 10 percent of the total agricultural land are comprised of floodplains, and therefore are vulnerable to flooding whenever a river or stream overflows its channel.

Earthquake Hazard

Millions upon millions of earthquakes have occurred through the course of human history. Some earthquakes have been catastrophic and others are so slight as to be inconsequential. More than one million tremors occur each year and nearly 80 percent of those are barely strong enough to rattle dishes.

The West Coast is the primary site of earthquake activity in the United States. In such areas, building codes and zoning regulations limit the height of buildings and otherwise minimize earthquake damage. And we can reduce building on terrains that are prone to sliding during earthquakes.

Volcano Hazard

A volcano is defined as a land form that consists of eruptive material, which accumulates around a vent in the earth's crust. Although eruptions of some volcanos are relatively peaceful, others are explosive and violent.

Until the explosion of Mount St. Helens in Washington State, little concern was expressed over the hazards of volcanos in the United States.

An explosive volcanic eruption can send fire and ash particles as well as steam and other gases into the stratosphere. Huge rock slabs and partially cooled masses of lava can be catapulted down to the earth's surface. If the volcano summit is covered with snow and ice, the heat of the eruption can cause rapid melting which can trigger landslides.

Landslide Hazard

Landslides are the downslope movements of masses of rock, soil, mud, or a mixture of those materials. Although some landslides are gradual, others are abrupt and sometimes catastrophic. In remote regions, landslides may pass unnoticed. In populated areas, they wreck homes, destroy sections of highways, and in some cases bury entire towns.

The West Coast of the United States is particularly prone to landsliding. That region is hilly and mountainous. Unfortunately, the hazard to humans in this region is increasing because as the demand for living space increases, more new housing subdivisions are built on slide-prone hillsides.

Although we are able to map areas of landslide susceptibility, our ability to control sliding is limited. The most effective strategy at the present time is to discourage construction in landslide-prone areas.

INFORMATION SHEET #7

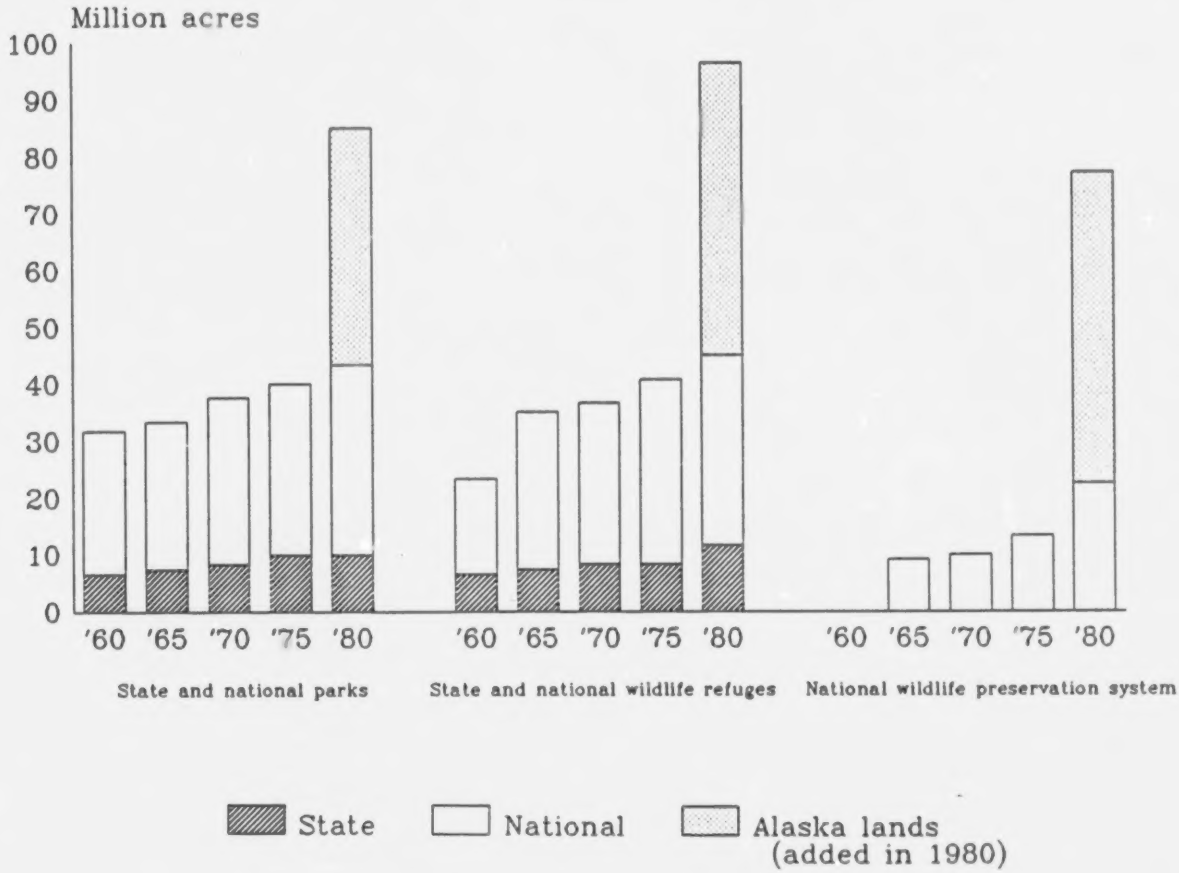
The Future

As the human population grows, the competition for our finite lands also increases. Conflicts over land use are bound to become more frequent. In the near future, our public lands will become the target of increasing pressure from resource developers. As our cities grow, more persons may live in areas that are prone to floods, earthquakes, and other natural hazards. Proper land-use planning will enable us to balance multiple users of land and to permit both land use and preservation.

TRANSPARENCY MASTER #1

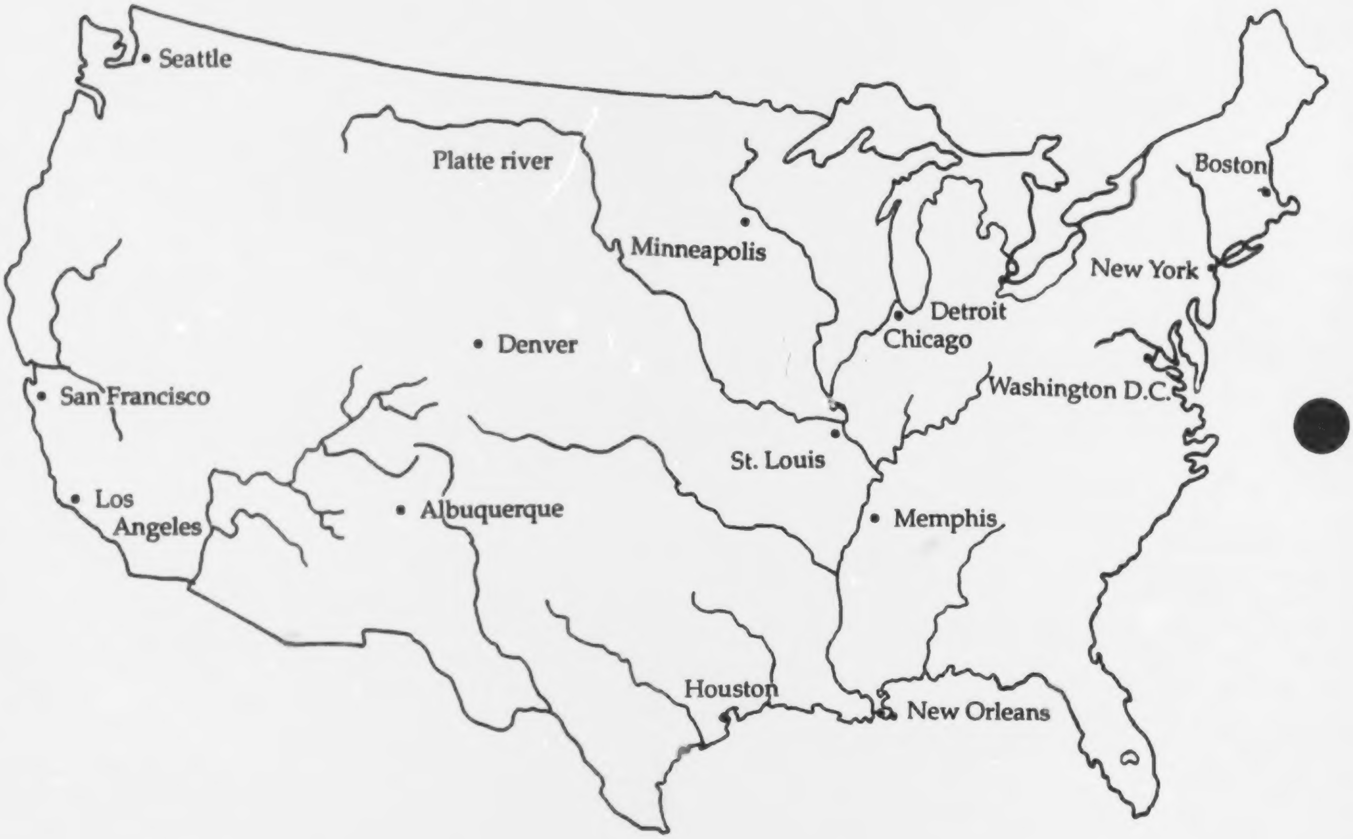
Parks, Wildlife Areas, and Wilderness in the United States

In 1980, 105 million acres (43 million hectares) of Alaskan lands were placed under federal protection. Those additions more than doubled the total area of the nation's parks, wildlife areas, and wilderness. (U.S. Department of the Interior, National Park Service, and U.S. Department of Agriculture, Soil Conservation Service)



TRANSPARENCY MASTER #2

Water and Urban Centers

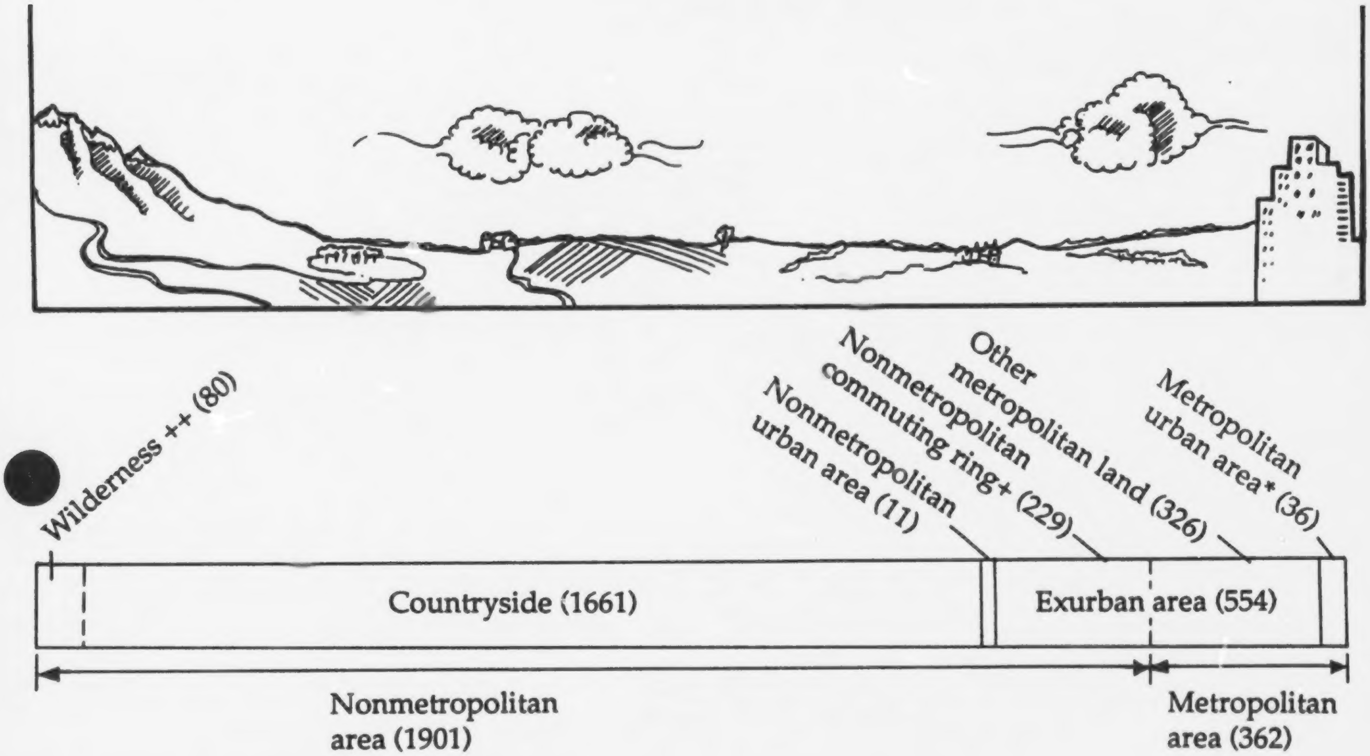

Seattle
Platte river
Minneapolis
Boston
New York
Detroit
Chicago
Denver
San Francisco
Washington D.C.
St. Louis
Los Angeles
Albuquerque
Memphis
Houston
New Orleans

Water is an important means of transportation. Each of the large urban centers is located on water, illustrating the importance of water as a determining factor in the growth of cities.

139 A

TRANSPARENCY MASTER #3

Development of Lands in the United States as of 1980


Wilderness ++ (80)
Nonmetropolitan urban area (11)
Nonmetropolitan commuting ring+ (229)
Other metropolitan land (326)
Metropolitan urban area* (36)
Countryside (1661)
Exurban area (554)
Nonmetropolitan area (1901)
Metropolitan area (362)

Total U. S. land area is 2,264 million acres

*Metropolitan urban area land includes 12.1 million acres in central cities and 24.2 million acres in suburban areas.

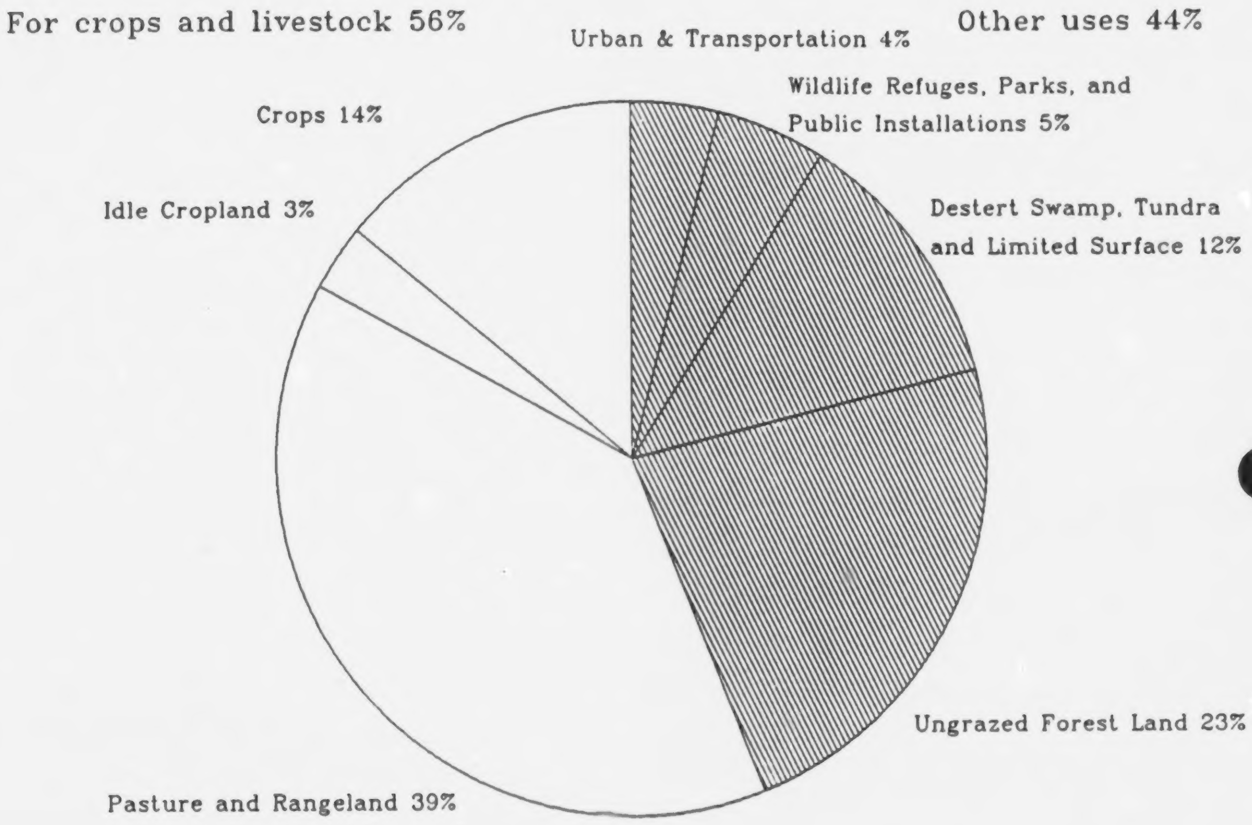
+Nonmetropolitan counties with 10% or more of resident workers commuting to metropolitan areas.

++Wilderness includes land in the National Wilderness

Adapted from: *The Conservation Foundation*, State of the Environment, 1982, p. 293.

TRANSPARENCY MASTER #4

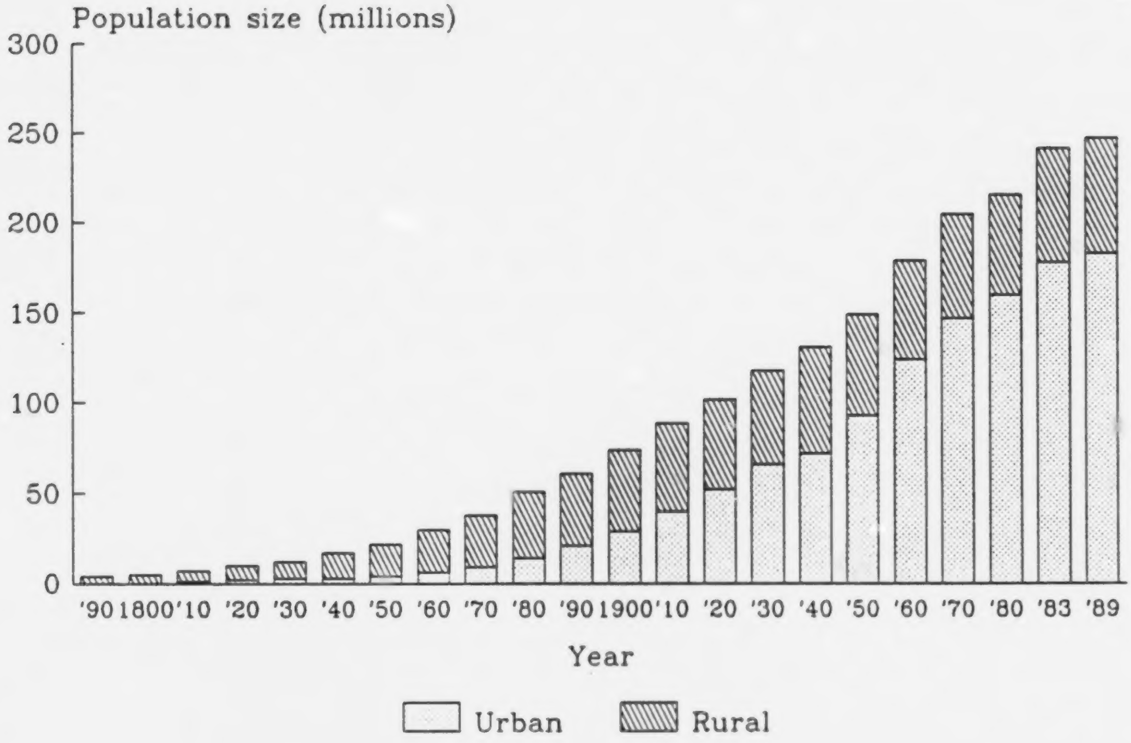
Land Use in the United States



Fifty-six percent of the land in the United States is used for crops and livestock, while only 4 percent is used for urban centers and transportation. (Source: *Statistical Abstracts of the United States*, 1990)

TRANSPARENCY MASTER #5

Rural to Urban Population Shift



In 1800, the United States was essentially a rural country. Industrialization in the late 1800s began the shift to an increasing urban population. (Adapted from "U.S.A. Population Changes, 1950 - 60," Population Bulletin, vol. 19, no. 2, Population Reference Bureau, March 1963 and World Population Data Sheet, Population Reference Bureau, 1984, 1989)

TRANSPARENCY MASTER #6

Twenty-Nine Supercities

The 29 supercities as determined in the 1980 census.

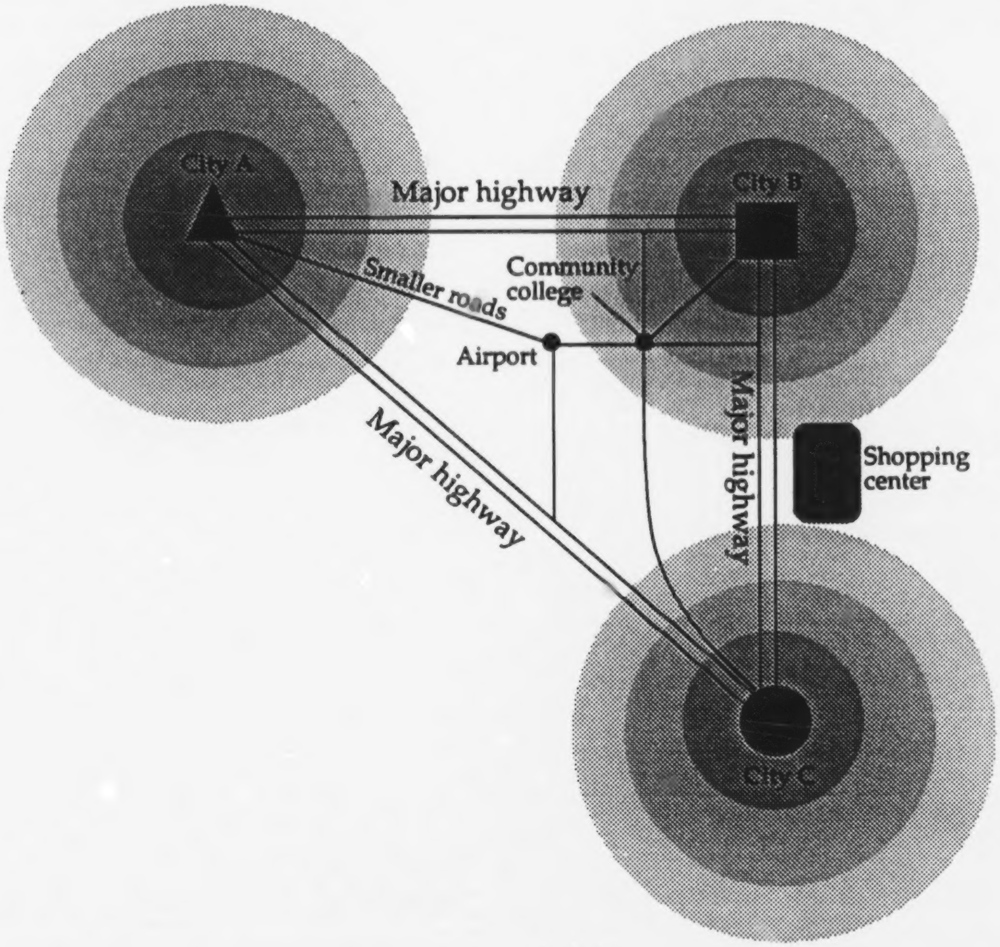
Supercity	1980 Population	Land Area (miles^2)	Population Density (people per square mile)
New York City/Northeastern New Jersey/Southern Connecticut	17,606,680	3,656	4,816
Los Angeles/Long Beach/San Bernardino/Riverside	10,184,611	2,187	4,657
Chicago/Northwest Indiana/Aurora/Elgin/Joliet	7,212,778	1,675	4,306
Dallas/Fort Worth	2,451,390	1,280	1,915
Philadelphia/Wilmington/Trenton	4,779,796	1,270	3,764
Houston/Texas City/Lamarque	2,521,857	1,169	2,157
San Francisco/San Jose	4,434,650	1,122	3,952
Boston/Brockton/Lowell/Lawrence/Haverhill	3,225,386	1,084	2,975
Detroit	3,809,327	1,044	3,649
Cleveland/Akron/Lorain/Elyria	2,493,475	989	2,521
Minneapolis/St. Paul	1,787,564	980	1,824
Atlanta	1,613,357	905	1,783
Miami/Fort Lauderdale/Hollywood/West Palm Beach	3,103,729	816	3,804
Washington, D.C.	2,763,105	807	3,424
Pittsburgh	1,810,038	713	2,539
Seattle/Everett/Tacoma	1,793,612	672	2,669
Phoenix	1,409,279	641	2,199
Newport News/Hampton/Norfolk/Portsmouth	1,099,360	614	1,790
San Diego	1,704,352	611	2,789
St. Louis	1,848,590	597	3,096
Kansas City	1,097,793	589	1,864
Tampa/St. Petersburg	1,354,249	527	2,570
Baltimore	1,755,477	523	3,357
Milwaukee	1,207,008	496	2,433
Cincinnati/Hamilton	1,228,438	465	2,642
Denver	1,352,070	439	3,080
Portland	1,026,144	349	2,940
Buffalo	1,002,285	266	3,768
New Orleans	1,078,299	230	4,688

Adapted from: L. Long and D. DeAre, "The Slowing of Urbanization in the U.S." © Scientific American 249(1):39, 1983.

TRANSPARENCY MASTER #7

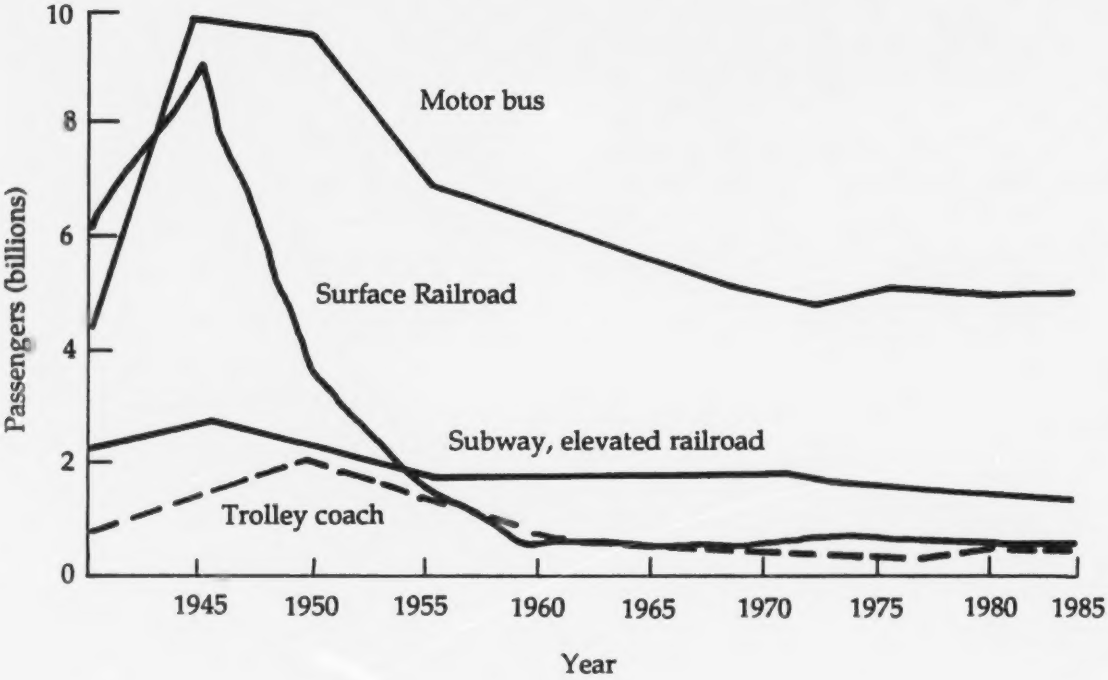
Loss of Farmland

As cities grow outward, in some places several cities will eventually grow together to form a regional area. The land once used for farming becomes conjested by transportation routes and facilities such as the airport, shopping center, and community college.


City A
Major highway
City B
Community college
Smaller roads
Airport
Major highway
Major highway
Shopping center
City C

TRANSPARENCY MASTER #8

Mass Transportation



TRANSPARENCY MASTER #9

World's Most Disastrous Earthquakes

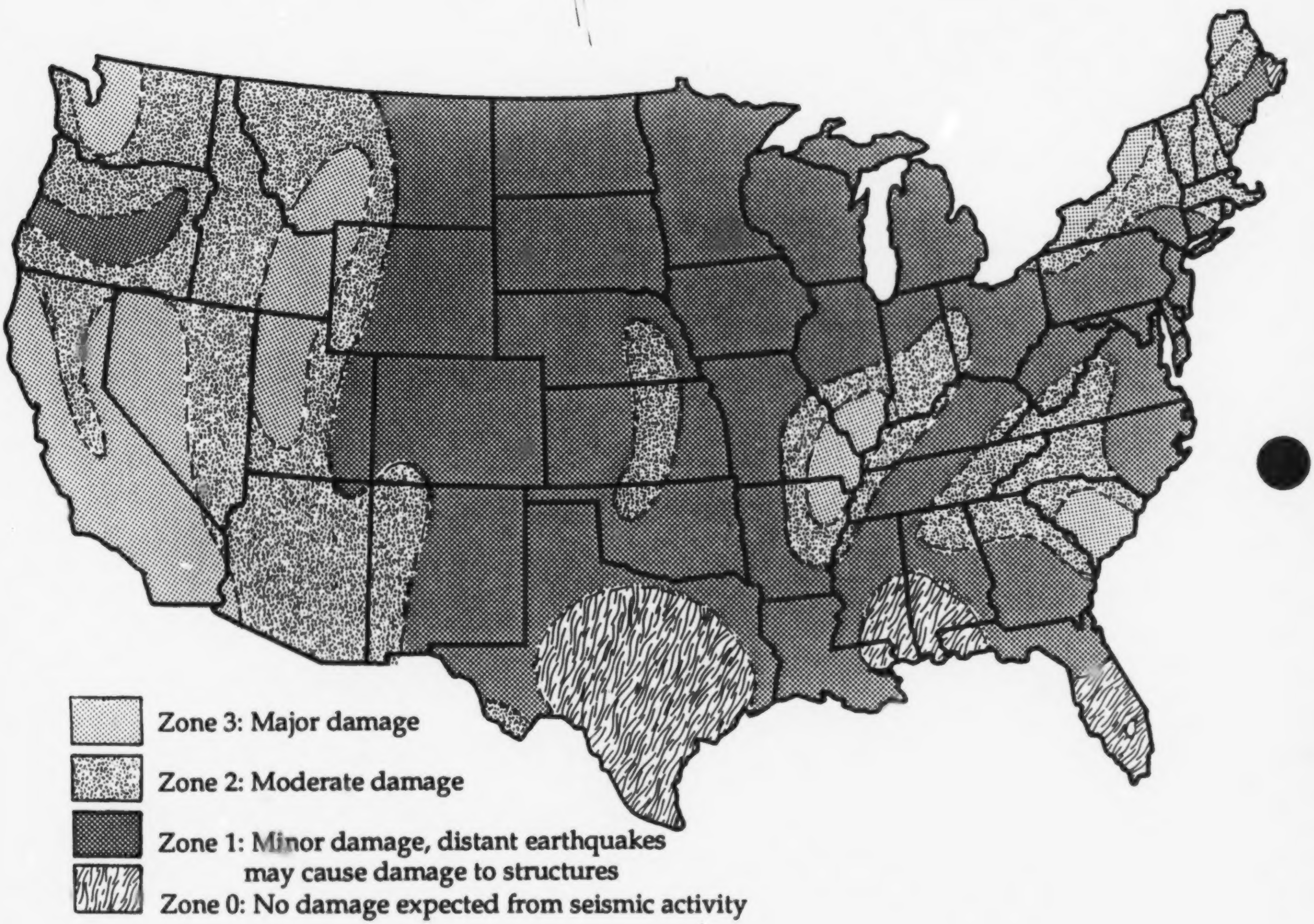
Some of the world's most disastrous earthquakes in terms of lives lost

Year	Place	Deaths(est)
856	Corinth, Greece	45,000
1268	Silicia, Asia Minor	60,000
1290	Chihli, China	100,000
1456	Naples, Italy	60,000
1556	Shen-shu, China	830,000
1731	Peking, China	100,000
1737	Calcutta, India	300,000
1908	Messina, Italy	160,000
1920	Kansu, China	180,000
1923	Tokyo, Japan	99,000
1932	Kansu, China	70,000
1935	Quetta, Baluchistan	60,000
1976	T'ang-shan, China	500,000
1988	Soviet Armenia	25,000
1990	Iran	35,000

Adapted from : F. Press and R. Siever, Earth, 3rd ed. New York: W. H. Freeman, 1982, p. 405.

TRANSPARENCY MASTER #10

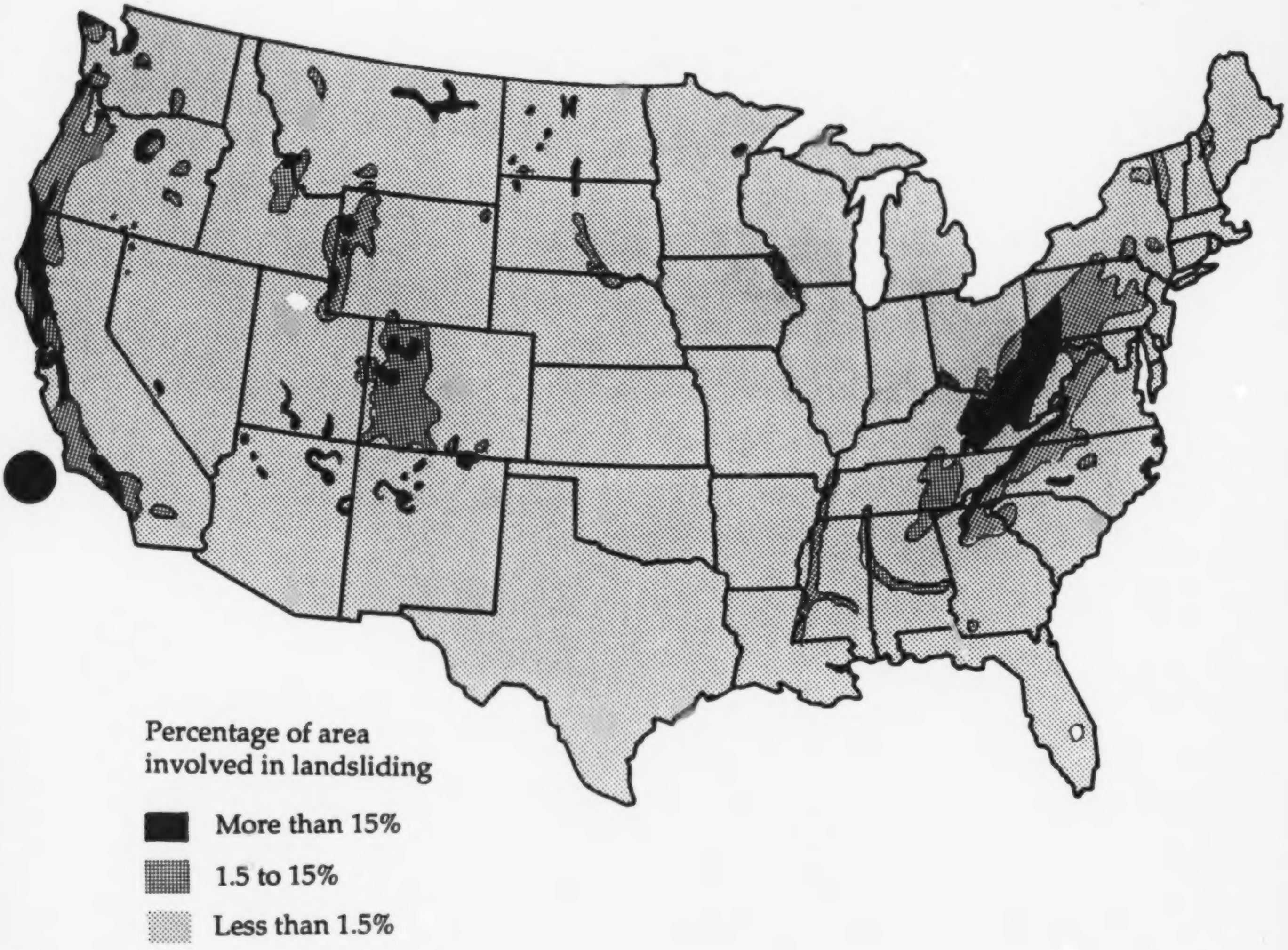
Zones of Earthquake Risk in the United States


Zone 3: Major damage
Zone 2: Moderate damage
Zone 1: Minor damage, distant earthquakes may cause damage to structures
Zone 0: No damage expected from seismic activity

Adapted from: U.S. Coast and Geodetic Survey, ESSA Rel. ES-1, January 14, 1969

TRANSPARENCY MASTER #11

Landslide Potential in the United States


Percentage of area involved in landsliding
More than 15%
1.5 to 15%
Less than 1.5%

After *the U.S. Geological Survey, Annual Report, 1976.*

STUDENT ACTIVITIES

STUDENT WORKSHEET #1 — Land-Use Role Play

For additional activities, teachers may refer to the "Suggested Teaching Activities and Procedures" section in the Instructor's Guide.

STUDENT WORKSHEET #1

Land-Use Role Play

A new interstate highway is being projected to run through your community. The interstate highway will be running north and south. You have been selected as a member of a planning committee to work with state officials in selecting the best possible route for the new highway.

1. From a plat book make a map of your community including the land area ten miles north and south of the high school.

2. Draw in the route you feel the interstate should take through your community.

3. How many acres of land will be used by the new highway?

4. What is the quality of the land being taken out of production?

5. What farm products had been grown on that land?

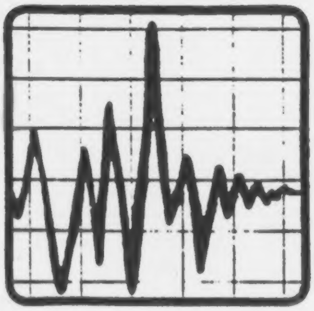
6. How many families will have to be relocated as a result of the new interstate?

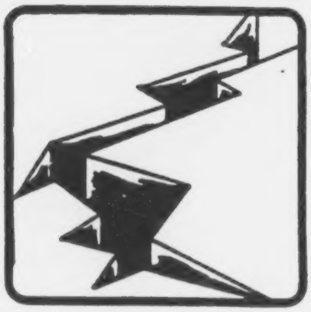
7. How will you proceed in acquiring the needed land from the owners?

8. Will the new interstate affect the economy of the local community?

9. Will the new interstate affect any recreational sites, wildlife habitats, or crime levels in the community?

10. Do you recommend the construction of the new interstate?





Earthquakes in the Illinois area

People living in northern Illinois might be surprised when a discussion of civil emergencies includes earthquakes. Tremors rarely occur in their part of the state. Travel southward, though, and the topic is more acceptable. Most people have felt tremors once or twice in a lifetime. Those living along the southern borders are especially concerned—because just south of Illinois lies the New Madrid seismic zone, the most active earthquake area in the central United States.

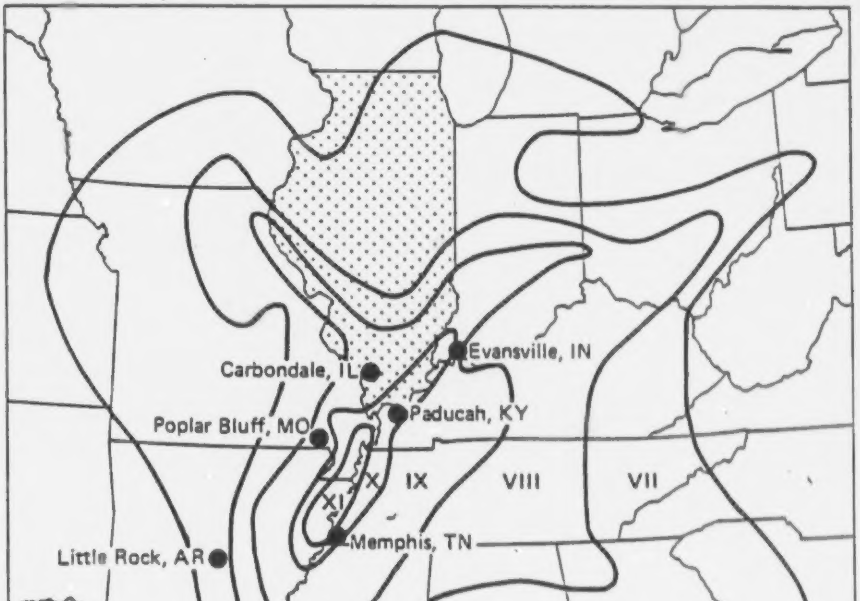
In the winter of 1811-12, three major earthquakes struck the area of New Madrid, Missouri, along the Mississippi River. No earthquake centered in Illinois during historic time has been as great. Between December and February, tremors were felt as far away as Washington, D.C. During that whole winter, nearly 2,000 more shocks occurred—all strong enough to be felt up to 200 miles away in Louisville, Kentucky.

The three strongest earthquakes were rated as "very disastrous" (see table). By the end of the winter, New Madrid was devastated. According to eyewitnesses, the ground rose in some places and subsided 20 feet or more in others. Large cracks appeared. Water spouts and sand plumes or "blows" erupted from the earth. Landslides were common, especially along the Mississippi River where banks collapsed into the water. In fact, the current flowed backward for a time, following an elevation in the riverbed. Fortunately, the region was sparsely populated.

A relic sand blow near Cairo, Illinois, indicates the strength or severity of the earthquake in southern Illinois. Today, a repeat of the New Madrid quakes would result in "ruinous damage" to parts of southern Illinois.

Since 1812, no shocks of this magnitude have occurred in the Midwest. One quake with an epicenter in the New Madrid area occurred in January 1843. Its maximum intensity was VIII on the Modified Mercalli Intensity Scale (see table). On this scale, VIII is generally the lowest intensity associated with serious damage to manmade structures. Another quake in October 1895, also located in the New Madrid region, had an intensity of IX.

By contrast, earthquakes centered in Illinois have been infrequent and relatively mild—small shocks causing little or no damage. In fact, many historic earthquakes of Illinois (see map inside) are not connected to the New Madrid seismic zone



Regional intensities (Mercalli Modified Intensity Scale) suggesting the possible effects of an earthquake as severe as the 1811 quake—if the epicenter occurred along the New Madrid seismic zone. Source USGS

FACTS ABOUT EARTHQUAKES

Earthquakes occur when rocks forming the earth's crust break—caused by the buildup of stresses greater than the strength of the rocks. Movement along the breaks is called *faulting.* When faulting takes place, the sudden release of energy produces vibrations or *seismic (shock) waves* that radiate from the main fault, often traveling long distances. These waves cause the shaking or "quaking" that lasts a few minutes to several hours, depending on what kinds of rocks they travel through and what paths they take. Where the faulting starts, at some depth below the Earth's surface, is the *focus* of an earthquake. The point on the surface directly above the focus is the *epicenter.*

Usually, the initial movement along the fault is relatively small. But after a short time, a much larger area shifts to relieve the main stress in the rocks. Although the time between the two events may be so brief that they cannot be felt separately, the initial shaking is called the *foreshock* and the principal break produces the *main shock.* As the surrounding rocks adjust, a series of *aftershocks* of decreasing magnitude and frequency usually occurs.

Magnitude and *intensity* are terms used to describe the severity of an earthquake, but they do not mean the same thing.

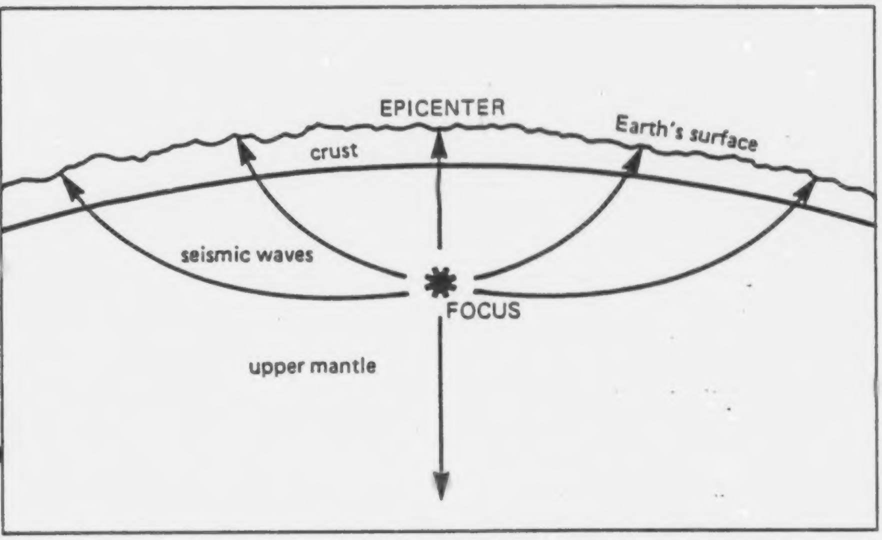
Magnitude is a measure of the total seismic energy released by rocks breaking and moving. Instruments called *seismographs* record the vibrations caused by ground movement. From these records, magnitude is calculated and expressed in Richter units. The Richter Scale is logarit mic, which means that magnitude 7 is many times greater than magnitude 6.

Intensity is an evaluation of the effects brought about by an earthquake, using th observations of people in the area affecte

- personal reactions (from disorienta tion to injury)
- property damage (from vibrating o overturned objects to collapsed stru tures)
- disturbances in land surface (from cracked ground to landslides)

Intensities are based on descriptive report rather than calculated from instrument readings. Values range from I to XII on the Modified Mercalli Intensity Scale (see table), increasing from barely detect able to catastrophic. For any earthquake there will be many intensities, dependin on location of observers—but only one magnitude.

Earth materials transmitting seismic wave also contribute to earthquake effects. Damage to buildings, dams, highways, power lines, and similar structures only partly depends on the amount of energy released during faulting. Certain kinds of earth materials enhance the vibration In Illinois, structures built on thick, loose sediments of river floodplains are more likely to be damaged than structures on glacial till (dense, pebbly clay) or bedrock. In fact, seismic intensity may increase as much as one full unit on the Modified Mercalli Intensity Scale if loose sediments are present. Also, loos sediments with a high moisture content can turn to liquid when shaken. Much remains to be learned about how differer rocks and loose deposits can reduce or enhance the severity of ground shaking.



*Adapted from Earthquakes: U.S. Department of the Interior/Geological Survey Brochure, 1981.

Modified Mercalli Scale of earthquake intensities

Intensity	Characteristic effects	Richter Scale magnitude
I Instrumental	detected only by seismography	
II Feeble	noticed only by sensitive people	3.5-4.2
III Slight	like the vibrations due to a passing heavy truck; felt by people at rest, especially on upper floors	
IV Moderate	felt by people while walking; objects rock, including standing vehicles	
V Rather strong	felt generally; most sleepers are awakened	4.3-4.8
VI Strong	trees sway; suspended objects swing; loose objects overturn or fall	4.9-5.4
VII Very strong	general alarm; walls crack; plaster falls	5.5-6.1
VIII Destructive	masonry cracks; chimneys fall; poorly constructed buildings damaged; water well levels may change	6.2-6.9
IX Ruinous	some houses collapse where ground begins to crack; pipes break open	
X Disastrous	ground cracks badly; many buildings destroyed and railway lines bent; landslides on steep slopes	7.0-7.3
XI Very disastrous	few buildings remain standing; bridges destroyed; all services (railway, pipes, and cables) out of action; great landslides and floods	7.4-8.1
XII Catastrophic	total destruction; objects thrown into air; ground rises and falls in waves	8.1+

*Adapted from Holmes, Arthur, 1965, Principles of Physical Geology: Ronald Press, NY, p. 901.

SEISMIC RESEARCH

The map of Illinois shows epicenters of historic earthquakes with intensities of V or greater. It also shows some major geologic structures in the bedrock. By mapping faults or folds, such as long arches *(anticlines)* and troughs *(synclines)*, geologists can pinpoint zones of weakness relatively near land surface. There is no evidence that any faults in these zones have moved in thousands of years.

To get information for mapping, geologists drill holes, take cores, and use various geophysical techniques. For example, they measure waves produced in subsurface earth materials by firing explosives placed in shot-holes. In Illinois, rocks have been studied only to a depth of about 13,000 feet.

Seismologists calculate the depth of an earthquake's focus in terms of *miles* below the surface. On November 9, 1968, for instance, an earthquake in southeastern Illinois had a focal depth of 12 miles. Another quake, occurring on September 15, 1972, in north-central Illinois, probably had a focal depth of about 3.6 miles—although it could have been as deep as 9 miles. Even the shallower quake began miles below the sequence of rocks mapped by geologists.

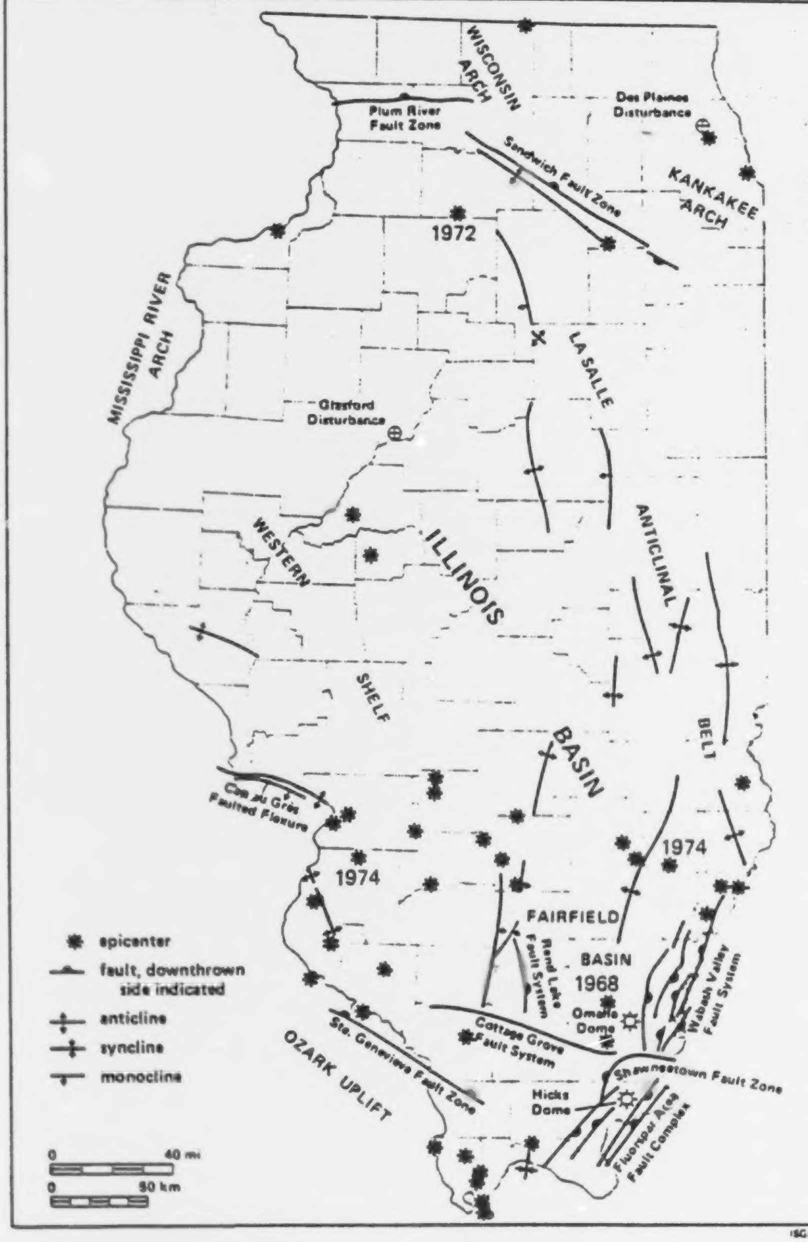
Because of the relatively uniform thickness of the Earth's crust in this part of the country, seismic energy radiating from shallow earthquake foci diminishes less rapidly than it does in the mountainous western states, where crustal thickness is less uniform. There is potential for damage over a greater area in the midcontinent.

Scientists continue to study the New Madrid seismic zone, the most active fault system in the Central Mississippi Valley. Using sensitive instruments to detect microearthquakes, researchers have been monitoring the area, collecting information, and putting together a detailed picture: the seismically active zone trends northeast from east-central Arkansas to the southern tip of Illinois in Alexander County and is approximately 120 miles long and 40 miles wide. Modern seismic surveying has confirmed that faulting in bedrock formations coincides with patterns of earthquake epicenters in southeastern Missouri. Scientists now believe that the New Madrid seismic zone is part of a deep rift in the Earth's crust extending northward from the Gulf of Mexico through the center of the Mississippi River Valley.

WHAT COULD HAPPEN IN ILLINOIS

Although earthquakes can occur *anywhere* in Illinois *at any time* (see map), most are likely to do little serious damage. The largest quakes to hit the state in historic times have been associated with the New Madrid seismic zone. In the 2000 years before 1811, according to geologic investigations made by the U.S. Geological Survey, two major earthquakes occurred in this fault zone. Apparently, recurrence time for an earthquake as severe as the quakes of 1811-12 is quite long. On the other hand, the U.S. Geological Survey estimates that enough strain energy has built up along the New Madrid fault zone since 1812 to produce shocks of 7.6 magnitude on the Richter Scale. Such an earthquake would be a disaster—disrupting services and utilities, destroying property, and causing great losses in lives.

What can we do to minimize the damage from earthquakes? How can we protect ourselves and our communities? What emergency services should we set up? Should we support scientific research into earthquakes and their effects? All these questions must be raised now. We are still a long way from being able to predict the time, place, and magnitude of future earthquakes. Yet we can be prepared.


WISCONSIN ARCH
Plum River Fault Zone
Des Plaines Disturbance
Sandwich Fault Zone
KANKAKEE ARCH
1972
LA SALLE
MISSISSIPPI RIVER ARCH
Glasford Disturbance
ANTICLINAL
ILLINOIS
WESTERN
SHELF
BASIN
BELT
Cap au Grès Faulted Flexure
1974
1974
FAIRFIELD
BASIN
1968
Rend Lake Fault System
Wabash Valley Fault System
Omaha Dome
Cottage Grove Fault System
Shawneetown Fault Zone
Ste. Genevieve Fault Zone
OZARK UPLIFT
Hicks Dome
Fluorspar Area Fault Complex
epicenter
fault, downthrown side indicated
anticline
syncline
monocline
0
40 mi
0
50 km

ISGS 1979

What You Can Do To Prepare Yourself For An Earthquake

Earthquakes can be disastrous primarily because of the damage that they do to the physical aspects of our society. Damaged or destroyed buildings, roadways, pipelines, electric utility lines, etc. can kill or injure people and result in the loss of millions of dollars in property over an affected area.

People can mitigate or lessen the severity of earthquake damage by identifying hazards that exist in their homes, schools, or places of business and then systematically removing or correcting each hazard.

Some common hazards include:

- Free standing water heaters, stoves, and other gas or electric appliances which could move or fall during an earthquake. Strapping such appliances to a wall or floor increases their safety.
- Bookshelves or filing cabinets which are free standing or bookshelves with objects stored above head level. These could be fastened together or to a wall or increase their stability and objects above head level should be removed.
- Water or gas pipes which are not fastened well to walls or ceilings. Increasing the number of fasteners or supports could prevent fracture and leakage.
- Large panes of glass which could fracture and fly apart. Such panes could be replaced by smaller panes or safety glass which would not fly apart as easily.

Some other things that people can do to make their homes more earthquake ready include:

- Keeping a few days supply of food and water available.
- Being sure each home has a fire extinguisher and smoke alarm.
- Maintaining a properly equipped first aid kit complete with any necessary prescription medication in sufficient quantities to last a few days to a few weeks.
- Organizing and testing a family emergency plan which would help ensure each family member's survival.

Should you be involved in an actual earthquake remembering a few simple facts can greatly increase your chance of survival and can help to reduce possibility of serious injury.

If inside a building:

- The greatest protection inside a building is found under heavy furniture or in doorways.
- Large rooms with open-span ceilings or roofs are the most vulnerable to collapse and should be avoided.
- Large windows or groups of windows can shatter and shards of glass can fly inward. These areas should also be avoided.
- Rooms with lots of fixtures or furniture can be a dangerous situation should the furniture or fixtures fall or slide.
- Some buildings are unable to withstand seismic forces and may collapse. These buildings will have to be evacuated in an orderly fashion.

If outdoors:

- Try to move away from buildings, especially those with masonry or glass-outer walls as these walls may literally fall off of buildings.
- Avoid electric utility lines which may fall or snap.
- Trees may also fall or limbs may break off. Avoid them if possible.
- Lie or sit down to avoid being thrown about by the quake.

Should you be in an automobile:

- Try to stop in a safe place and stay in the car. The suspension system of the car will absorb the ground movement.

The most important aspect of riding the quake out is to remain calm. Panic only adds to injury in many cases.

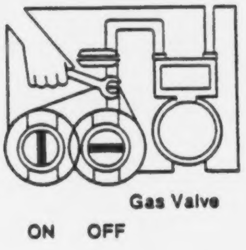
After the shaking has stopped, the danger from an earthquake may still not be over. Ruptured gas lines or downed power lines may still present life threatening hazards. Fractured water mains may be a nuisance and can add to property damage and impede firefighting efforts. Dams may breach and inundate areas downstream. Traffic and access to damaged areas may be obstructed. The occurrence of aftershocks also needs to be considered as the situation in an area may change drastically.

Some things to be considered immediately after an earthquake include:

- Buildings in danger of collapse may need to be evacuated quickly.
- First aid needs to be rendered to those in need.
- Gas and electric service to a building may need to be turned off by someone previously trained to these tasks.
- Small fires should be extinguished if equipment is available for the purpose and there is no threat to life from such actions.

Be sure that everyone is accounted for after the quake.

Families, businesses, schools, or individuals may have to be self-sufficient for a period of time after an earthquake. Preparations taken before an earthquake may greatly enhance people's ability to do this and may make life tolerable in unpleasant surroundings.



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Printed by authority of State of Illinois

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Thomas W. Ortciger, Director
James R. Thompson, Governor
Morris Leighton, Chief

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Environmental Protection

PROBLEM AREA: Managing Freshwater Resources

RELATED PROBLEM AREAS:

1. Controlling Air Pollution
2. Managing Land Resources
3. Managing Forestry Resources
4. Understanding Government Regulations and Controls
5. Understanding the Relationship Between Agriculture and the Environment (Central Core Cluster)
6. Conserving Agricultural Resources (Central Core Cluster)

PREREQUISITE PROBLEM AREA(S):

1. Conserving Water Resources

LEVEL: Orientation

OCCUPATIONAL TASKS ADDRESSED:

Agricultural Resources Cluster

Duty A: Managing the Recreational Facility

1. Contribute to annual park management update
2. Determine land-use capability
3. Assist in development of resource conservation plan

Duty B: Applying Laws, Regulations, and Policies

1. Interpret stream, lake, pond, and groundwater laws
2. Interpret Environmental Protection Agency (EPA) regulations

Duty G: Assembling, Servicing, and Maintaining Equipment and Facilities

1. Inspect water and sewer systems
2. Maintain grounds and recreation areas
3. Maintain facility culverts
4. Maintain facility drainage ditches

STATE GOALS FOR LEARNING

In planning the instruction for this problem area, teachers can promote the development of several student learning objectives which are related to the State Goals for Learning in Biological and Physical Sciences and Social Sciences. These objectives are listed on the Learning Assessment Plan forms included on the following page(s). Those learning objectives marked with an asterisk (*) are taken from the sample lists provided by the Illinois State Board of Education.

Illinois Agricultural Core Curriculum

Agricultural Education 124 Mumford Hall 1301 W. Gregory Drive University of Illinois Urbana, IL 61801

Director: Dale A. Law, Ed.D.
Principal Investigator: Jerry D. Pepple, Ed.D
Research Assistant: Kevin J. Enderlin

Illinois Agricultural Core Curriculum Rev.

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

Submission Date ____________________

☐ **Original submission** ☐ **Revision**

Page ____ of ____

(Affix label or complete district information.)

COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐

District Name

City

I. LEARNING AREA *(check one)*

☐ Language Arts
☐ Mathematics
☐ Sciences
☐ Fine Arts
☒ Social Sciences
☐ Physical Development/Health

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will be able to apply the skills and knowledge gained in the social sciences to decision making in life situations.

Contact Person: ______________________________
Title: ______________________________
Phone: (   )

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Understand the knowledge and skills required for success in selected fields of work.					
*2. Recognize that competence in a field of work entails the development of a wide range of skills.					
3. Correctly collect a water sample for testing.					
4. Interpret a water analysis report.					
5. Explain the parts of a water treatment plant.					
6. Understand the purposes of chemicals used in water purification.					

ISBE 41-78 (1/88)

Managing Freshwater Resources

Agricultural Resources
Environmental Protection

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
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Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

Submission Date ____________
☐ **Original submission** ☐ **Revision**
Page ____ of ____

I. LEARNING AREA *(check one)*
☐ Language Arts
☐ Mathematics
☐ Sciences
☐ Fine Arts
☒ Social Sciences
☐ Physical Development/Health

(Affix label or complete district information.)

COUNTY	DISTRICT	ESC

District Name

City

Contact Person: ____________
Title: ____________
Phone: (   )

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will be able to demonstrate a knowledge of world geography with an emphasis on the United States.

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Understand how decisions affecting the use of the natural environment can have both positive and negative results.					
2. Estimate groundwater contamination potential.					
3. Discuss what can be done to protect groundwater supplies.					
4. Describe the importance of watersheds and how watersheds help to prevent water pollution.					

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Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

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Submission Date ____________________
☐ Original submission ☐ Revision
Page ____ of ____

(Affix label or complete district information.)
COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐
District Name
City

I. LEARNING AREA *(check one)*

☐ Language Arts
☐ Mathematics
☒ Sciences
☐ Fine Arts
☐ Social Sciences
☐ Physical Development/Health

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will have a working knowledge of the concepts and basic vocabulary of biological, physical, and environmental sciences and their application to life and work in contemporary technological society.

Contact Person: ____________________
Title: ____________________
Phone: (   )

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Recognize that good conservation practices depend on understanding the balance between living things and their environment.					
*2. Examine the dynamics of a fresh water system.					
*3. Identify factors that could alter the rate of change in an environment.					
4. Discuss management practices of rivers, lakes, and streams used to protect and enhance the quality of that water.					
5. Discuss what can be done to protect groundwater supplies.					
6. Understand the importance of watersheds and how watersheds help to prevent water pollution.					

ISBE 41-78 (1/88)

Submission Date ______

☐ **Original submission** ☐ **Revision**

Page ____ of ____

I. LEARNING AREA *(check one)*

☐ Language Arts
☐ Mathematics
☒ Sciences
☐ Fine Arts
☐ Social Sciences
☐ Physical Development/Health

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

(Affix label or complete district information.)

COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐

District Name

City

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will have a working knowledge of the social and environmental implications and limitations of technological development.

Contact Person: ______
Title: ______
Phone: ( )

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Understand ways that people can minimize the depletion of the earth's resources.					
*2. Evaluate the ways in which natural resources have been allocated, utilized, and conserved in the nation.					
3. Select pesticides based on partition coefficient and half-life.					
4. Estimate groundwater contamination potential.					
5. Understand the purposes of chemicals used in water purification.					

ISBE 41-78 (1/88)

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Environmental Protection

PROBLEM AREA: Managing Freshwater Resources

STUDENT LEARNING OBJECTIVES

Upon completion of their study of this problem area, students will be able to:

1. Select pesticides based on partition coefficient and half-life.
2. Estimate groundwater contamination potential.
3. Discuss management practices of rivers, lakes, and streams used to protect and enhance the quality of that water.
4. Discuss what can be done to protect groundwater supplies.
5. Correctly collect a water sample for testing.
6. Interpret a water analysis report.
7. Explain the parts of a water treatment plant.
8. Understand how raindrop impact affects soil erosion and water pollution.
9. Understand how water runoff impacts soil erosion and water pollution.
10. Describe the importance of watersheds and how watersheds help to prevent water pollution.
11. Understand the purposes of chemicals used in water purification.

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Environmental Protection

PROBLEM AREA: Managing Freshwater Resources

PROBLEMS AND QUESTIONS FOR STUDY	INSTRUCTOR'S NOTES AND REFERENCES

1. What is partition coefficient?
2. What is half-life?
3. What is groundwater contamination?
4. How does one measure groundwater contamination?
5. How does groundwater contamination occur?
6. How can groundwater supplies be protected?
7. What steps are necessary to properly collect a water sample?
8. How does one properly collect a water sample?
9. What information is on a water analysis report?
10. What does the information on the water analysis report mean?
11. How does rain affect soil erosion?
12. How does soil erosion affect water pollution?
13. How does water runoff affect soil erosion and water pollution?
14. What are watersheds?
15. Why are watersheds important?
16. How do watersheds help prevent water pollution?
17. What chemicals are used in water purification?
18. What is the function of the chemicals used in water purification?

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Environmental Protection

PROBLEM AREA: Managing Freshwater Resources

SUGGESTED TEACHING ACTIVITIES AND PROCEDURES

1. Visit a local sewage treatment plant.
2. Visit a local water treatment plant.
3. Collect water samples, send them in for testing, and analyze the results.
4. Identify watersheds from aerial photos.
5. Visit a farm that controls agricultural sources of water pollution. Your local Soil and Water Conservation District can help arrange the tour.
6. Estimate the amount of water used by students each day.
7. Determine raindrop impact on soil erosion and water pollution (see Student Worksheet #1).
8. Determine the effect of water runoff on soil erosion and water pollution (see Student Worksheet #2).
9. Determine how many streams or rivers are in a 20-mile radius from your school. Name them.
10. Visit a farm and identify the sources of point and non-point water contamination.

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Environmental Protection

PROBLEM AREA: Managing Freshwater Resources

REFERENCES

*1. *Environmental Science: How the World Works and Your Place in It.* Person, Jane L. (Rev. 1990). J. M. LeBel Enterprises, 6420 Meadow Creek Drive, Dallas, TX 75240. (217) 661-0687.

*2. *Clean Safe Water, For How Long?* Illinois Environmental Protection Agency, Public Information, 2200 Churchill Road, Springfield, IL 62708. (217) 782-3397.

3. *Your Illinois World, A Guide Book to Individual Action on Environmental Action.* Illinois Environmental Protection Agency, Public Information, 2200 Churchill Road, Springfield, IL 62708. (217) 782-3397.

4. *Acid Precipitation.* Soil Conservation Society of America, Water Quality and Management, Illinois Cooperative Extension Service, 69C Mumford Hall, 1301 West Gregory Drive, Urbana, IL 61801 (or local office).

5. *Agricultural Resources — Introductory Occupations, Land, Water, and Air Management,* 0114A. Instructional Materials Service, P.O. Box 2588, Texas A & M University, College Station, TX 77843-2588.

*Indicates highly recommended reference

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTIONAL RESOURCES

These resources are intended for use by teachers in planning and teaching the materials for this problem area and may be adapted to fit the teaching method(s) used.

INFORMATION SHEET #1 — Pesticide Terms to be Defined

INFORMATION SHEET #2 — Estimating Groundwater Contamination by Pesticides

INFORMATION SHEET #3 — Grouping of Pesticides Based on Persistence in Soils

INFORMATION SHEET #4 — Partition Coefficients (PC) for Selected Pesticides

INFORMATION SHEET #5 — What is a Watershed?

INFORMATION SHEET #6 — Water Quality Management of Rivers, Lakes, and Streams

INFORMATION SHEET #7 — What Can We Do to Protect Our Groundwater Supplies?

INFORMATION SHEET #8 — How to Take a Water Sample for Nitrates and Coliform

INFORMATION SHEET #9 — How to Interpret a Water Analysis Report

TRANSPARENCY MASTER #1 — Water Treatment Plant

TRANSPARENCY MASTER #2 — Purposes of Chemicals Used in Water Purification

INFORMATION SHEET #1

Pesticide Terms to be Defined

Runoff — physical transport of pollutants over the soil surface by rainwater that does not soak into the soil.

Run-in — physical transport of pollutants directly to groundwater.

Persistence — ability of a pesticide to resist degradation or breakdown.

Half-life — amount of time it takes for one-half of the original amount of pesticide in the soil to be deactivated, or lose its ability to work effectively.

Solubility — ability of a pesticide to dissolve in water.

Partition Coefficient — ratio of the pesticide bound to soil particles to the pesticide dissolved in the soil water.

170

INFORMATION SHEET #2

Estimating Groundwater Contamination by Pesticides

1. Determine partition coefficient of pesticide.
2. Determine half-life of pesticide.
3. Refer to table to estimate groundwater contamination potential.

Table. Combining the PC value and half-life of a pesticide to determine its potential to contaminate groundwater by leaching.

Partition Coefficient (PC)	Half-life	Groundwater Contamination Potential
small	long	high
small	short	moderate
large	short	low

INFORMATION SHEET #3

Grouping of Pesticides Based on Persistence in Soils

Non-Persistent
(half-life less than or equal to 30 days)

Herbicides
generic name (trade name)

Alachlor (Lasso)
Bifenox (Modown)
Butylate (Sutan +, Genate Plus)
Chlorpropham (Furloe)
Cyanazine (Bladex)
Dicamba (Banvel)
Dalapon (Dowpon)
Dinoseb (Premerge)
EPTC (Etam, Eradicane, Genep)
Propachlor (Ramrod)
Tridiphane (Tandem)
Vernolate (Vernam, Reward)
2, 4 - D

Insecticides, Fungicides, and Nematicides

Aldicarb (Temik)
Captan
Diazonon (Spectracide)
Malathion
Phorate (Thimet)

Moderately Persistent
(half-life greater than 30 days, less than 100 days)

Herbicides
generic name (trade name)

Acifluorfen (Blazer, Tackle)
Atrazine (AAtrex)
Bentazon (Basagran)
Chloramben (Amiben)
Ethalfluralin (Sonolan)
Glyphosate (Roundup, Kleenup)*
Linuron (Lorox, Linex)
Metolachlor (Dual)
Metribuzin (Sencor, Lexone)
Oryzalin (Surflan)
Pendimethalin (Prowl)
Simazine (Princep, Aquazine)
Triclopyr (Garlon)
Trifluralin (Treflan)

Insecticides, Nematicides

Carbaryl (Sevin)
Carbofuran (Furadan)
Chlorpyrifos (Lorsban)
Endrin
Fonofos (Dyfonate)
Parathion (Niram, Parathion)

Persistent
(half-life greater than or equal to 100 days)

Herbicides
generic name (trade name)

Bromacil (Hyvar)
Fluchloralin (Basalin)
Paraquat (Gramoxone)*
Picloram (Tordon)
Terbacil (Sinbar)

Insecticides

Chlordane
Dieldrin
Heptachlor
Lindane (Isotox, Silvanol)

*These pesticides have no herbicidal activity when absorbed (chemically attached) to soil clay particles and organic matter. They are present but inactivated.

Adapted from: *Your Illinois World, A Guide Book to Individual Action on Environmental Action*, IEPA

INFORMATION SHEET #4

Partition Coefficients (PC) for Selected Pesticides

Pesticide generic name (trade name)	PC	Pesticide generic name (trade name)	PC
Dicamba (Banvel)	11	Prometone (Conquer, Pramitol)	300
Aldicarb (Temik)	12	Diuron (Karmex, Krovar, Velpar)	383
Chloramben (Amiben)	13	Propachlor (Ramrod)	420
Picloram (Tordon)	26	Diazinon (Spectracide)	580
Carbofuran (Furadan)	29	Chlorpropham (Furloe)	589
2, 4 - D	32	Linuron (Lorox)	863
Captan	33	Lindane (Lintox, Silvanol)	1,161
Terbacil (Sinbar)	46	Malathion (Cythion)	1,797
Fonofos (Dyfonate)	68	Phorate (Thimet)	3,200
Dinoseb (Premerge)	120	Terbufos (Counter)	4,796
Monuron (Urox)	132	Chloroxuron (Tenoran)	4,986
Simazine (Princep, Aquazine)	138	Methylparathion	7,079
Atrazine (AAtrex)	163	Parathion (Thiophos)	7,161
Dichlobenil (Casoron)	164	Dieldrin	8,400
Cyanazine (Bladex)	168	Chloropyrifos (Lorsban)	13,490
Alachlor (Lasso)	190	Trifluralin (Treflan)	14,000
Propazine (Milogard)	207	Heptachlor	24,000
Carbaryl (Sevin)	229	Chlordane	38,000
		DDT	243,000

INFORMATION SHEET #5

What is a Watershed?

Watershed — On land, water that does not evaporate or soak into the soil usually drains into ditches, streams, marshes, or lakes. The land area from which water drains to a given point is a watershed.

Flooding — If too much water runs away too rapidly, it causes a flood that damages farms, ranches, crops, property, homes, highways, and utilities.

Soil and water conservation practices — Water can be slowed down and used to advantage when soil and water conservation practices are utilized over the entire watershed area. Terraces, strip cropping, and more grass and legumes in crop rotations cause more water to soak into the soil for use of crops and pasture.

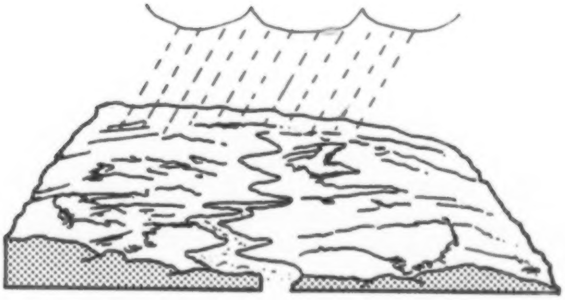


Diagram of a watershed.

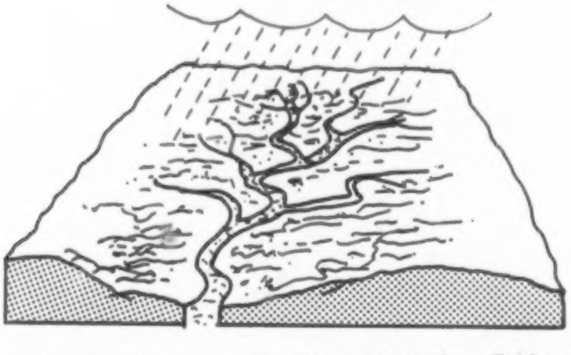


Diagram of the same watershed with the farm fields, trees, buildings, and roads removed to show the drainage pattern.

State of Illinois

174

INFORMATION SHEET #6

Water Quality Management of Rivers, Lakes, and Streams

1. Limit chemical treatments — Control the flow of nutrients into lakes and streams by avoiding overuse of fertilizers, pesticides, herbicides, and other soluble chemicals.

2. Consider fertilizers carefully — If you feel you must fertilize, consider using a non-phosphorus or low-phosphorus fertilizer. Aim for a fertilizer mixture containing five percent phosphorus or less. Many lawns do not need phosphate fertilizer. Of lawns tested, only five percent needed phosphorus.

3. Control fertilizer runoff — Keep fertilizer off hard surfaces where it can join storm water and wash into the nearest body of water. Even if you don't live on a lake shore, you may be contributing to the pollution of lakes and streams.

4. Maintain ground cover — Adequate ground cover and plants in watersheds absorb water, slow runoff, guard against erosion, and filter nutrients.

5. Preserve wetlands — Wetlands are a crucial component of any watershed. Wetlands provide natural treatment of waterborne and airborne pollutants and act as a filtering system.

6. Divert nutrients — Water pollution begins on land. Effective water management depends in great part on how we manage the land surrounding the water. The worst place to manage any body of water is in the water itself.

INFORMATION SHEET #7

What Can We Do to Protect Our Groundwater Supplies?

1. When storing, mixing, or loading pesticides, or when rinsing containers, conduct these activities as far from wells as possible.
2. Minimize back-siphonage possibilities by installing back-flow prevention devices and keeping hose ends out of chemical tanks.
3. Read and follow label instructions. Labels provide legal as well as production information.
4. Triple-rinse containers immediately after emptying, and crush or puncture top and bottom of containers to prevent reuse.
5. After triple-rinsing, consult label for disposal instructions. Avoid burying unless in a permitted sanitary landfill.
6. Return rinse water to spray tanks and apply rinse water to crops according to application instructions, or use rinse water to mix new spray solutions of the same pesticide.
7. Maintain and calibrate pesticide application equipment to apply the product properly.
8. Scout and monitor weed, insect, and disease problems. Apply pesticides only when the benefit of using it exceeds the cost.
9. Test soil for organic matter and texture to assure correct application rate.
10. If feasible, apply herbicides in a band along the crop row. This can be economically as well as environmentally beneficial.

INFORMATION SHEET #8

How to Take a Water Sample for Nitrates and Coliform

1. Always contact the lab where you plan to have the water tested and ask them for sampling methods, containers, and packaging and delivery instructions.

2. It is usually best to test the sample as soon as possible. The lab should receive the water sample and perform the test within 48 hours after the sample was taken.

3. For most accurate results, water samples should always be collected by a disinterested third party trained in proper sample collection procedures. Samples should be tested by the Department of Public Health Lab or a certified laboratory.

Illinois Department of Public Health
(217) 782-6562

4. Even if no obvious water problems exist, household water should be tested annually for pH, nitrates, total coliform bacteria, and total dissolved solids.

Record of Household Water Tests

Year	Date	pH 6.8 to 7.5*	Nitrates NO_3-N 10 ppm*	Total Coliform Bacteria 0/100ml*	Total Dissolved Solids 500ppm*	Other
1987						
1988						
1989						
1990						
1991						
1992						
1993						
1994						
1995						
1996						
1997						
1998						
1999						
2000						

ppm = parts per million ml = milliliters
*Acceptable limits without treatment

INFORMATION SHEET #9

How to Interpret a Water Analysis Report

Reports of water analysis from testing laboratories include many of the following items. This fact sheet will assist you in interpreting the report and help you make decisions about water conditioning.

Item	Acceptable limits without treatment	Effects of concentrations above acceptable limits
Alkalinity (CO_3, HCO_3)	400 ppm	High alkalinity (pH 8.0+) may have "soda" taste and drying effect on the skin
Carbon dioxide	not specified	High concentrations and a low pH cause corrosion
Chlorides (Cl)	250 ppm	Brackish or briny taste and water is usually corrosive
Copper (Cu)	1.0 ppm	May impart bitter taste, can be toxic and cause liver damage
Fluorides (F)	0.7 to 1.2 ppm	Optimum levels prevent tooth decay; however, higher levels may cause brown stains and damage teeth
Iron (Fe)	0.3 ppm	Imparts metallic taste to water and leaves yellow stains on everything it contacts
Manganese (Mn)	0.05 ppm	Similar to iron, leaves black specks on bathroom fixtures
Nitrates (NO_3)	45 ppm	Higher concentrations usually indicate sewage pollution, may be fatal to infants (blue baby disease)
Sulfates (SO_4)	250 ppm	Produces medicinal taste and may have a laxative effect on those not accustomed to it; generally means extreme hardness and low pH
Total dissolved solids	500 ppm	May settle out and build up scale in pipeline and water heaters
Total hardness* (Ca & Mg)	1.0 to 7.0 gpg or 20 to 110 ppm**	Wastes soap, cleans poorly, leaves spots on dishes and glassware, and causes lime scale in water heaters, pipe, and bulk milk handling equipment
pH value	6.8 to 7.5	pH values below 6.5 may result in corrosive water; pH values higher than 7.5 usually indicate hard water
Stability index	6.5 to 7.0	Index numbers less than 6.0 indicate that the water is scale forming (will deposit scale in pipe); numbers greater than 7.5 indicate the water is corrosive and will rust pipe
Saturation index	not specified	Similar to stability index, a positive (+) number indicates scale-forming tendency; a negative (-) number indicates the water may be corrosive.

---

*Hardness classification

1.0 to 3.5 gpg	Relatively soft water
3.5 to 7.0 gpg	Moderately hard water
7.0 to 10.5 gpg	Hard water
10.5 plus gpg	Very hard water

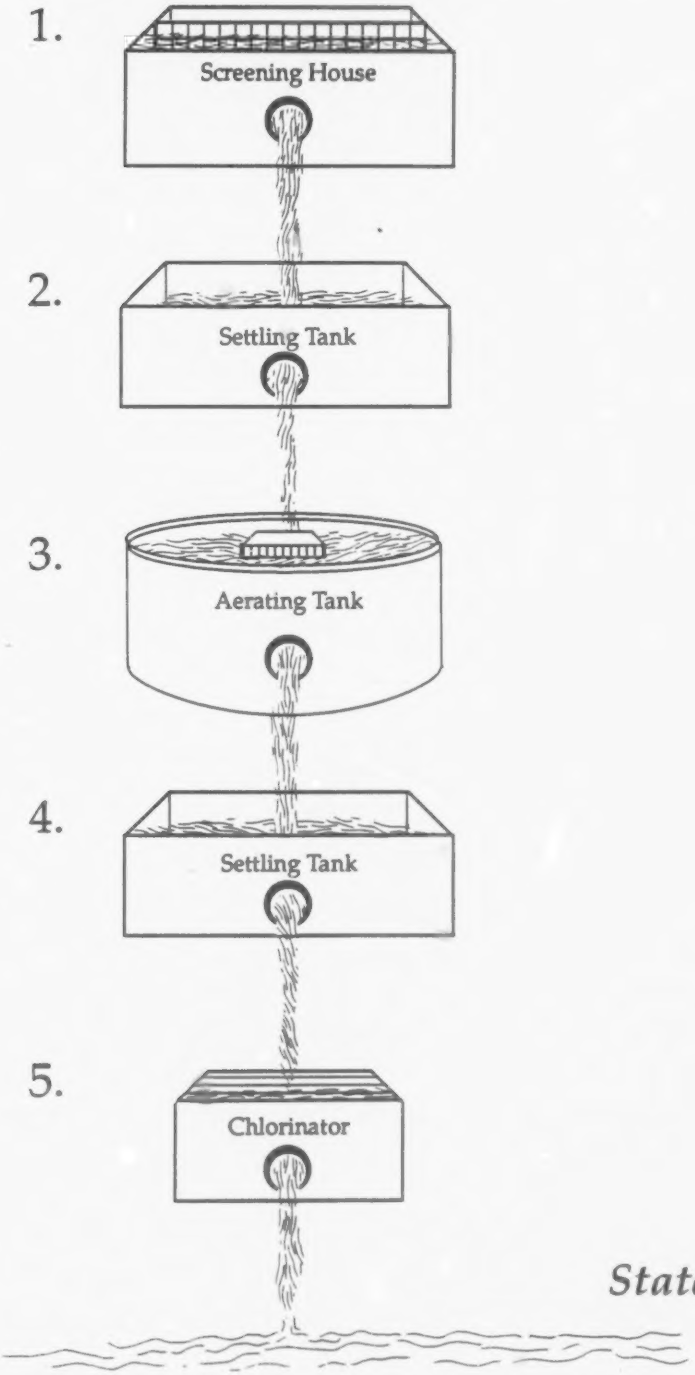
**Conversion formula

1 gpg = 17.1 ppm or gpg = pp , 17.1

Illinois Environmental Protection Agency

TRANSPARENCY MASTER #1

Water Treatment Plant


1.
Screening House
2.
Settling Tank
3.
Aerating Tank
4.
Settling Tank
5.
Chlorinator

State of Illinois

TRANSPARENCY MASTER #2

Purposes of Chemicals Used in Water Purification

Name	Purpose
Activated carbon	taste and odor removal
Activated silica	aid to precipitation
Aluminum sulfate (alum)	causes precipitation
Calcium hydroxide (lime)	aid to precipitation — pH adjustment softens water
Chlorine	sanitizes — destroys bacteria and controls algae that cause taste and odor problems
Copper sulfate (blue stone)	algae control
Ferric chloride (iron)	causes precipitation
Ferrous sulfate (iron)	causes precipitation
Polyelectrolytes	aid to precipitation
Sodium carbonate (soda ash)	softens water
Sodium hexametaphosphate (calgon)	stabilization — prevents red water

Adapted from : *Instructional Materials Service*

STUDENT ACTIVITIES

STUDENT WORKSHEET #1 — Raindrop Impact on Soil Erosion and Water Pollution

STUDENT WORKSHEET #2 — Water Runoff and Soil Erosion and Water Pollution

For additional activities, teachers may refer to the "Suggested Teaching Activities and Procedures" section in the Instructor's Guide.

STUDENT WORKSHEET #1

Raindrop Impact on Soil Erosion and Water Pollution

Materials:

Two wooden stakes approximately 107 centimeters long (3 ½ feet) and 10 centimeters wide (4 inches) — painted white. Sprinkling can.

Procedure:

Locate two adjacent spots on the schoolgrounds with different amounts of grass cover (for example, one with heavy sod, and one area with no grass cover; one area of cropland or garden crops, and one with sod cover). Place stakes in the ground and use the sprinkling can to simulate rainfall. Note the height of soil particles splashed on the stakes and the amount of soil splashed from each area. The raindrop impact loosens soil particles. After the particles are loosened, they are then able to be carried by water runoff.

State of Illinois

STUDENT WORKSHEET #2

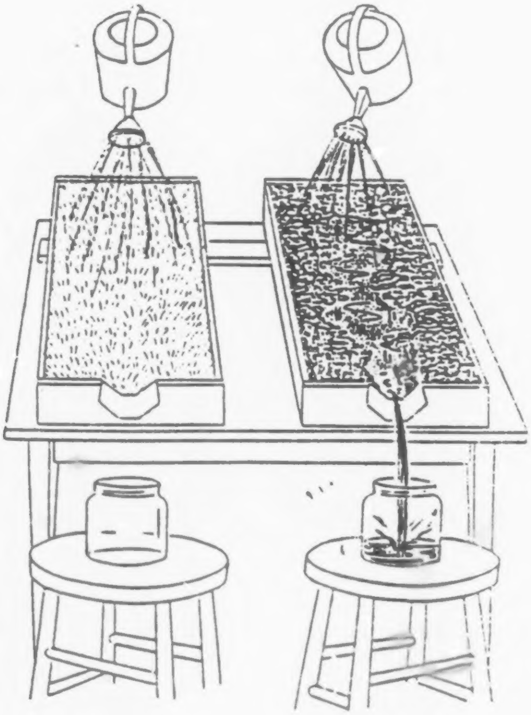
Water Runoff and Soil Erosion and Water Pollution

Materials:

Two waterproof boxes about 41 centimeters long (16 inches), 31 centimeters wide (12 inches), and 10 centimeters deep (4 inches); at one end of each box, cut a V-notch. Two fruit jars. Two sprinkling cans.

Procedure:

Fill both boxes with soil, leaving one box with no vegetation, and the second box with sod cover. Place boxes on an angle with the notched end being the lower end. Place the jars under the notches to catch runoff water. Use the sprinkling cans to simulate rainfall. By comparing the runoff water caught in the jars, determine which box lost the most soil and why. Further experiments can be done with the boxes. Using two boxes of soil with no vegetation, make small ridges (terraces) across the slope on one box, leaving the other bare; or place straw mulch on the soil in one box, leaving the second box with bare soil. Compare runoff from each different "field."



UNIT B: Forestry

PROBLEM AREAS:

1. Classifying Trees
2. Identifying Trees and Forestry Products
3. Managing Forestry Resources
4. Producing Christmas Trees
5. Processing Forestry Products

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Forestry

PROBLEM AREA: Classifying Trees

RELATED PROBLEM AREAS:

1. Identifying Basic Principles of Plant Science (Central Core Cluster)
2. Conserving Agricultural Resources (Central Core Cluster)
3. Conserving Wildlife Resources (Agricultural Business and Management Cluster)
4. Classifying Plants (Agricultural Business and Management Cluster)
5. Understanding Plant Anatomy and Physiology (Horticulture Cluster)

PREREQUISITE PROBLEM AREA(S): None

LEVEL: Preparatory

OCCUPATIONAL TASKS ADDRESSED:

Agricultural Resources Cluster

Duty A: Managing the Recreational Facility

1. Determine land-use capability
2. Assist in development of resource conservation plans

Duty D: Managing Facility Flora and Fauna

1. Identify plant communities and dominant species within a selected area
2. Identify native plant species within a selected area

STATE GOALS FOR LEARNING

In planning the instruction for this problem area, teachers can promote the development of several student learning objectives which are related to the State Goals for Learning in Biological and Physical Sciences. These objectives are listed on the Learning Assessment Plan forms included on the following page(s). Those learning objectives marked with an asterisk (*) are taken from the sample lists provided by the Illinois State Board of Education.

Illinois Agricultural Core Curriculum

Agricultural Education 124 Mumford Hall 1301 W. Gregory Drive University of Illinois Urbana, IL 61801

Director: Dale A. Law, Ed.D.
Principal Investigator: Jerry D. Pepple, Ed.D
Research Assistant: Byron Mackey

90/91
Agricultural Resources
Forestry

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

Submission Date__________

☐ **Original submission** ☐ **Revision**

Page ____ of ____

(Affix label or complete district information.)

COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐

District Name

City

Contact Person: __________

Title: __________

Phone: ( )

I. LEARNING AREA *(check one)*

☐ Language Arts
☐ Mathematics
☒ Sciences
☐ Fine Arts
☐ Social Sciences
☐ Physical Development/Health

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will have a working knowledge of the concepts and basic vocabulary of biological, physical, and environmental sciences and their application to life and work in contemporary technological society.

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Compare living organisms by applying a classification scheme.					
2. List some ways trees are commonly classified.					
3. Explain the scientific names for trees.					
4. Define the word taxonomy.					
5. Define terms associated with tree classification.					
6. Relate similarities among the species of trees and identify a species with economic potential for cultivation.					

187

188

Classifying Trees

Agricultural Resources
Forestry

ISBE 41-78 (1/88)

Illinois Agricultural Core Curriculum Rev.

Classifying Trees

Submission Date ____________________

☐ Original submission ☐ Revision

Page ____ of ____

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LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

(Affix label or complete district information.)

COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐

District Name

City

I. LEARNING AREA *(check one)*

- ☐ Language Arts
- ☐ Mathematics
- ☒ Sciences
- ☐ Fine Arts
- ☐ Social Sciences
- ☐ Physical Development/Health

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will have a working knowledge of the process, techniques, methods, equipment, and available technology of science.

Contact Person: ____________________

Title: ____________________

Phone: (   )

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Construct a classification scheme and demonstrate its use.					

Agricultural Resources
Forestry

ISBE 41-78 (1/88)

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Forestry

PROBLEM AREA: Classifying Trees

STUDENT LEARNING OBJECTIVES

Upon completion of their study of this problem area, students will be able to:

1. List some ways trees are commonly classified.
2. Explain the scientific names for trees.
3. Define the word taxonomy.
4. List the classification of trees native to Illinois.
5. Identify the major native trees in the area.
6. Define the word dendrology.
7. Differentiate between the two main groups of trees, angiosperms and gymnosperms.
8. Properly identify important trees native to Illinois when given leaf or fruit samples.
9. Define terms associated with tree classification.
10. Relate similarities among the species of trees and identify a species with economic potential for cultivation.

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Forestry

PROBLEM AREA: Classifying Trees

PROBLEMS AND QUESTIONS FOR STUDY

1. What are the advantages of using scientific names for plants?
2. Who created this system for naming living things?
3. What are the various methods of classifying trees?
4. What is a scientific name?
5. Where does a scientific name come from?
6. What is the purpose of having scientific names for living things?
7. Given common names of trees, what are their scientific names?
8. What is an Angiospermae?
9. What is a Gymnospermae?
10. How do you determine if a tree is an Angiospermae or a Gymnospermae?
11. Could you be creative and develop your own classification scheme to organize objects?
12. Could you demonstrate the use of your classification scheme?
13. How does one tell the difference between species of trees that are in the same family?

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Forestry

PROBLEM AREA: Classifying Trees

SUGGESTED TEACHING ACTIVITIES AND PROCEDURES

1. Use other science personnel as resource persons for materials and ideas.
2. Use local governmental agencies as resources for publications and speakers. Some examples are:
    a. Illinois Department of Conservation.
    b. United States Park Service.
    c. Cooperative Extension Service.
3. Use university departments and affiliated research sites as sources for speakers, publications, materials and as field trip sites. Some examples are:
    a. Southern Illinois University.
    b. Western Illinois University.
    c. Illinois State University.
    d. University of Illinois.
    e. Local community colleges.
    f. Forest preserves and parks.
4. Conduct field trips to experiment stations, parks, forests, and local nurseries.
5. Utilize the Student Worksheets at appropriate points during the subject matter presentation as hands-on activities.
6. Use the enclosed Transparency Masters as visual aids to supplement subject matter presentation.
7. Begin the problem area with an interest approach. Examples:
    a. Write on the board "Why do we classify things?" Have students list the reasons we classify or group things.
    b. Divide students into groups of three to five. Provide them with many different sizes, shapes, textures, and colors of stones or other objects. Give each group ten minutes to group or classify items in a manner they choose. Have each group show the other class members how they classified their objects. This should indicate to the students that one can group or classify objects in many different ways. The same is true for trees.
8. Give students several common trees and have them look up genus and species names.
9. Collect tree samples for identification.
10. Collect flowers and fruit of conifers and broadleaf trees. Describe how they differ.
11. Make a collection of five broadleaf tree twigs and leaves, and five coniferous tree twigs and needle specimens.
12. Have students collect specimens of specific genera and identify similarities within each group as to foliage, fruit, and seeds.
13. Review bark and leaf characteristics of conifers in photographs.
14. Make a living plant collection of representative trees.
15. Collect 20 tree samples in an area and classify them into different classification systems.
16. Study 20 different trees and place them into major categories based on similarity of fruits, flowers, and foliage.
17. Discuss the descriptive nature of scientific names, for example, alba = white.
18. Use referenced texts and publications as student resources for additional specific information.
19. Refer to Transparency Masters #6 and #7 in problem area *Classifying Plants*.

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Forestry

PROBLEM AREA: Classifying Trees

REFERENCES

1. *Forestry: Agricultural Science II Core Curriculum Student Reference.* Catalog number HG-118-8. Instructional Materials Laboratory, University of Missouri-Columbia, Columbia, MO.

2. *Forestry: An Instructional Program in Vocational Education.* California Vocational Agriculture Curriculum Guidelines. Vocational Education Productions, California Polytechnic State University, San Luis Obispo, CA 93407.

3. *Agricultural Education: Basic Agricultural Skills Modules.* The University of the State of New York/The State Education Department, Bureau of Technology, Trade and Agricultural Programs, Albany, NY 12234.

*4. *Forests and Forestry.* Holland, I.I., Rolfe, G.L., and Anderson, D.A. Interstate Publishers, Inc., P.O. Box 50, Danville, IL 61834-0050 (217) 446-0500.

*5. *Forest Trees of Illinois.* Mohlenbrock, R.H. Department of Conservation, Division of Forest Resources and Natural Heritage, 524 South Second Street, Springfield, IL 63701-1787.

*Indicates highly recommended reference

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTIONAL RESOURCES

These resources are intended for use by teachers in planning and teaching the materials for this problem area and may be adapted to fit the teaching method(s) used.

INFORMATION SHEET #1 — Terms to be Defined

INFORMATION SHEET #2 — Classification of Trees

INFORMATION SHEET #3 — Methods of Tree Classification

INFORMATION SHEET #4 — Modern Classification System

INFORMATION SHEET #5 — Common and Scientific Names of Illinois Trees

INFORMATION SHEET #6 — Key to the Trees of Illinois in Spring, Summer, and Fall

TRANSPARENCY MASTER #1 — Leaf Edges, Tips, and Bases

TRANSPARENCY MASTER #2 — Leaf Forms and Arrangements

INFORMATION SHEET #1

Terms to be Defined

Taxonomy — The science which deals with the classification and naming of organisms.

Genus — A collection of closely related species.

Species — A collection of plants of a single kind.

Variety — A subclassification of species; a slight difference in one of the characteristics.

Scientific name — The use of the Latin language to identify a living thing by its genus and species taxonomic classification; used to identify a specific living thing.

Codominant — Trees with crowns forming the general level of the crown cover and receiving full light from above, but comparatively little from the sides; usually the medium-sized crowns more or less crowded on the sides.

Cover, crown — The canopy of green leaves and branches formed by the crowns of all trees in a forest.

Crown — The branches and foliage of a tree; the upper portion of a tree.

Diameter class — All trees in a stand whose diameters are within prescribed limits.

Pubescent — Bearing fine, woolly hairs such as on leaves, twigs, or buds.

Softwood — One of the botanical group of trees that generally have needle or scalelike leaves, the conifers; also, the wood produced by such trees regardless of texture or density.

Species (of trees) — Subordinate to a genus; trees having common characteristics. In common language, species is a kind of variety.

Hardwood — Generally, one of the botanical group of trees that have broad leaves, in contrast to the needle-bearing conifers; also wood produced by broad-leaved trees regardless of texture or density.

Class, age — One of the intervals into which the range of ages of vegetation is divided for classification and use.

Class, crown — A designation of trees in a forest with crowns of similar development and occupying similar positions in the crown cover. Differentiation into crown classes is intended for application to the way even-aged stands are often arranged. The following four crown classes are commonly recognized: dominant, codominant, intermediate, and overtopped (suppressed).

Class, diameter — One of the intervals into which the range of diameters of trees in a forest is divided for purposes of classification and use.

Taxon (plural taxa) — A taxonomic group of plants of any rank such as family, genus, species, and so forth.

Spermatophyte — A seed-bearing plant.

Tree — A woody plant having one well-defined stem and a more or less definitely formed crown, usually attaining a height of at least eight feet.

Wood — The lignified water-conducting, strengthening, and storage tissue of branches, stems, and roots.

Deciduous — Term applied to trees which drop their leaves in the fall.

Silvics — The life history and general characteristics of forest trees and stands, with particular reference to environmental factors.

Dendrology — The identification and systematic classification of trees.

Conifer — A tree belonging to the order Coniferae, usually evergreen, with cones and needle-shaped leaves, and producing wood. Known commercially as "softwood."

INFORMATION SHEET #2

Classification of Trees

There are two classes of trees. One, made up of coniferous species, is called Gymnospermae. The other, the hardwood species, is called Angiospermae. The classes are in turn divided into orders, the names of which end in "ales." Oaks, for example, are members of the Fagales.

Orders are made up of one or more families, the names of which generally end in "aceae." For example, the oaks are members of the family Fagaceae. Also included in this family are the chestnuts and beeches.

Families are made up of one or more genera which in turn are made up of species. Each individual plant, such as sweet gum, white oak, and long leaf pine, is given both a generic and a species name. Carl von Linne (Linnaeus), the Swedish botanist, was the first to use this system of classifying plants and is called the "father" of systematic botany.

In the use of scientific names for trees, the generic name is always written first and is capitalized, while the species name which follows is spelled in lower case, thus Acer rubrum (red maple). However, the scientific name of a species is, in many instances, followed by the abbreviation of or full last name of the person who described and named the species. Thus, water oak, common to the South, is Quercus nigra L. The "L" stands for Linnaeus who first described the species.

Latin has been used in taxonomy because it is a so-called dead language. It is the language of no particular nation today and is not subject to change. To some extent Greek is used in taxonomy.

INFORMATION SHEET #3

Methods of Tree Classification

A. Physical characteristics

1. Age
2. Crown
    a. Dominant
    b. Codominant
    c. Intermediate
    d. Overtopped
3. Diameter

B. Leaf Retention

1. Deciduous
2. Evergreen

C. Habitat Requirements

1. Climate
    a. Moisture
    b. Temperature
2. Soils
    a. Texture
    b. Drainage
    c. pH
3. Competition (Can the plant grow in the sun or the shade?)

D. Usefulness

1. Lumber value
2. Crop plants
3. Erosion control
4. Browse value
5. Poisonous plants
6. Wildlife habitat

E. Leaf Arrangement

1. Simple
2. Opposite
3. Pinnately compound
4. Alternate
5. Palmately compound
6. Doubly pinnately compound
7. Whorled

F. Leaf Shapes

1. Lanceolate
2. Oblanceolate
3. Oblong
4. Elliptical
5. Ovate
6. Obovate

G. Leaf Tips

1. Acute
2. Obtuse
3. Long tapering

H. Leaf Edges

1. Pinnately lobed
2. Wavy
3. Toothed
4. Doubly toothed
5. Smooth

I. Leaf Bases

1. Heart shaped
2. Truncate
3. Asymmetrical
4. Rounded
5. Tapering

INFORMATION SHEET #4

Modern Classification System

1. Use of Latin or scientific names

   A. Based on the principle that all living organisms are classified on the basis of similarity of structure and function.

   B. The greater the similarity of any two organisms, the closer the relationship.

   Example:

	Ponderosa Pine	**Sugar Pine**	**Lodgepole Pine**
Genus:	Pinus	Pinus	Pinus
Species	ponderosa	lambertiana	contorta

   C. Capitalize all Latin words except the species and variety which are never capitalized.

2. Scientific Classification

Kingdom	Plant
Division	Spermatophyte
Subdivision	Gymnospermae
Order	Coniferales
Family	Pinaceae
Genus	Abies
Species	magnifica
Variety	shastensis

Refer to definitions.

Genus — Example: All true firs have similar needle and fruit (cone) characteristics.

Species — Example: All white fir (Abies concolor) have the same bark, needle, cone, and seed characteristics.

Variety — Example: California Red fir (Abies magnifica) and Shasta Red fir (Abies magnifica shastensis) are varieties whose only difference is the Shasta Red fir cones having bracts which extend beyond the cone scales.

INFORMATION SHEET #5

Common and Scientific Names of Illinois Trees

Scientific Name	Common Name
Acer barbatum Michx.	Southern Sugar Maple
Acer negundo L.	Box Elder
Acer nigrum Michx.	Black Maple
Acer rubrum L.	Red Maple
Acer rubrum L. var. drummondii	Swamp Red Maple
Acer saccharinum L.	Silver Maple
Acer saccharum Marsh.	Sugar Maple
Aesculus discolor Pursh.	Red Buckeye
Aesculus glabra Wild.	Ohio Buckeye
Ailanthus altissima (Mill.) Swingle	Tree-of-Heaven
Alnus glutinosa (L.) Gaertn.	Black Alder
Amelanchier arborea (Michx.f.) Fern.	Shadbush
Amelanchier laevis Wieg.	Smooth Shadbush
Aralia spinosa L.	Hercules' Club
Asimina triloba Dunal	Pawpaw
Betula lutea Michx.	Yellow Birch
Betula nigra L.	River Birch
Betula papyrifera Marsh.	Paper Birch
Broussonetia papyrifera (L.) Vent.	Paper Mulberry
Carpinus caroliniana Walt.	Blue Beech
Carya aquatica (Michx.f.) Nutt.	Water Hickory
Carya cordiformis (Wang.) k. koch	Bitternut Hickory
Carya glabra (Mill.) Sweet	Pignut Hickory
Carya illinoensis (Wang.) k. koch	Pecan
Carya laciniosa (Michx.f.) Loud.	Kingnut Hickory
Carya ovalis (Wang.) Sarg.	Sweet Pignut Hickory
Carya ovata (Mills.) k. koch	Shagbark Hickory
Carya texana Buckl.	Black Hickory
Carya tomentosa (Poir.) Nutt.	Mockernut Hickory
Castanea dentata (Marsh.) Borkh.	Chestnut
Catalpa bignonioides Walt.	Common Catalpa
Catalpa speciosa Engelm.	Catalpa
Celtis laevigata Willd.	Sugarberry
Celtis occidentalis L.	Hackberry
Celtis tenuifolia Nutt.	Dwarf Hackberry
Cercis canadensis L.	Redbud
Cladrastis lutea (Michx.f.) k. koch	Yellowwood
Cornus alternifolia L.	Alternate-Leaved Dogwood
Cornus drummondii Meyer	Rough-Leaved Dogwood
Cornus florida L.	Flowering Dogwood
Crataegus crus-galli L.	Cock-spur Thorn
Crataegus mollis (Torr. & Gray) Scheele	Red Haw
Crataegus pruinosa (Wendle.) k. koch	Pruinose Haw
Diospyros virginiana L.	Persimmon
Fagus grandifolia Ehih.	Beech
Forestiera acuminata (Michx.) Poir	Swamp Privet
Fraxinus americana L.	White Ash
Fraxinus nigra Marsh.	Black Ash
Fraxinus pennsylvanica Marsh.	Red Ash
Fraxinus pennsylvanica Marsh. var. subintegenima (Vahl) Fern.	Green Ash
Fraxinus quadrangulata Michx.	Blue Ash

Scientific Name	Common Name
Fraxinus tomentosa Michx. f.	Pumpkin Ash
Gleditsia aquatica Marsh.	Water Locust
Gleditsia triacanthos L.	Honey Locust
Gymnocladus dioicus (L.) k. koch	Kentucky Coffee Tree
Halesia carolina L.	Silver Bell
Hamamelis virginiana L.	Witch Hazel
Ilex decidua Walt.	Swamp Holly
Juglans cinerea L.	Butternut
Juglans nigra L.	Black Walnut
Juniperus virginiana L.	Red Cedar
Larix decidua Mill.	European Larch
Larix laricina (DuRoi) k. koch	American Larch
Liquidambar styraciflua L.	Sweet Gum
Liriodendron tulipifera L.	Tulip Tree
Maclura pomifera Schneid.	Osage Orange
Magnolia acuminata L.	Cucumber Magnolia
Malus angustifolia (Ait.) Michx.	Narrow-Leaved Crab Apple
Malus coronaria (L.) Mill.	Prairie Crab Apple
Malus ioensis (Wood) Britt.	Iowa Crab Apple
Morus alba L.	White Mulberry
Morus rubra L.	Red Mulberry
Nyssa aquatica L.	Tupelo Gum
Nyssa sylvatica Marsh.	Sour Gum
Ostrya virginiana (Mill.) k. koch	Hop Hornbeam
Paulownia tomentosa (Thunb. Stend.)	Princess Tree
Pinus banksiana Lamb.	Jack Pine
Pinus echinata Mill.	Shortleaf Pine
Pinus resinasa Ait.	Red Pine
Pinus strobus L.	White Pine
Pinus sylvestris L.	Scotch Pine
Pinus taeda L.	Loblolly Pine
Planera aquatica Gmel.	Water Elm
Platanus occidentalis L.	Sycamore
Populus alba L.	White Poplar
Populus deltoides Marsh.	Cottonwood
Populus grandidentata Michx.	Big-Tooth Aspen
Populus heterophylla L.	Swamp Cottonwood
Populus tremuloides Michx.	Quaking Aspen
Prunus americana Marsh.	Wild Plum
Prunus hortulana Bailey	Wild Goose Plum
Prunus serotina Ehih.	Wild Black Cherry
Prunus virginiana L.	Choke Cherry
Ptelea trifoliata L.	Wafer Ash
Quercus alba L.	White Oak
Quercus bicolor Willd.	Swamp White Oak
Quercus coceinea Muench.	Scarlet Oak
Quercus ellipsoidalis E.J. Hill	Hill's Oak
Quercus falcata Michx.	Spanish Oak
Quercus imbricaria Michx.	Shingle Oak
Quercus lyrata Walt.	Overcup Oak
Quercus macrocarpa Michx.	Bur Oak
Quercus marilandica Muench.	Blackjack Oak
Quercus michauxii Nutt.	Swamp Chestnut Oak
Quercus muehlenbergii Engelm.	Yellow Chestnut Oak
Quercus pagodaefolia Ell.	Cherrybark Oak

Scientific Name	Common Name
Quercus palustris Muench.	Pin Oak
Quercus phellos L.	Willow Oak
Quercus prinus L.	Rock Chestnut Oak
Quercus rubra L.	Northern Red Oak
Quercus shumardii Buckl.	Shumard's Oak
Quercus stellata Wang.	Post Oak
Quercus velutina Lam.	Black Oak
Rhammus caroliniana Walt.	Carolina Buckthorn
Rhammus cathartica L.	Common Buckthorn
Rhus copallina L.	Shining Sumac
Rhus glabra L.	Smooth Sumac
Rhus typhina L.	Staghorn Sumac
Rhus vernix L.	Poison Sumac
Robinia pseudoacacia L.	Black Locust
Salix amygdaloides Anders.	Peach-Leaved Willow
Salix carolinaina Michx.	Carolina Willow
Salix interior Rowlee	Sandbar Willow
Salix nigra Marsh.	Black Willow
Sassafras albidum (Nutt.) Nees	Sassafras
Taxodium distichum (L.) Rich.	Bald Cypress
Tilia americana L.	Basswood
Tilia helerophylla Vent.	White Basswood
Ulmus alata Michx.	Winged Elm
Ulmus americana L.	American Elm
Ulmus pumila L.	Siberian Elm
Ulnus rubra Muhl.	Slippery Elm
Ulmus thomasii Sarg.	Rock Elm
Viburnum lentago L.	Sweet Viburnum
Virurnum prunifolium L.	Black Haw
Viburnum rufidulum Raf.	Rusty Nannyberry

INFORMATION SHEET #6

Key to the Trees of Illinois in Spring, Summer, and Fall

1. Leaves needle-like or scale-like — Group A
1. Leaves broad and flat, never needle-like or scale-like
   2. Leaves compound (divided into three or more leaflets) — Group B
   2. Leaves simple
      3. Leaves opposite or whorled — Group C
      3. Leaves alternate
         4. Leaves neither toothed nor lobed — Group D
         4. Leaves toothed or lobed or both
            5. Leaves toothed but not lobed — Group E
            5. Leaves lobed — Group F

Group A

Leaves needle-like or scale-like, often evergreen.

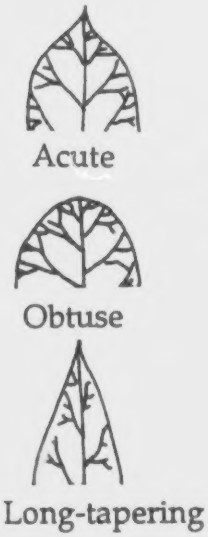
1. Leaves in clusters of two or more
   2. Leaves in clusters of ten or more, falling off during autumn
      3. Leaves blue-green; cone-scales smooth *Larix laricina*
      3. Leaves bright green; cone-scales hairy *Larix decidua*
   2. Leaves in clusters of 2-5, evergreen
      4. Leaves in clusters of 5 *Pinus strobus*
      4. Leaves in clusters of 2-3
         5. Leaves in clusters of two
            6. Most or all leaves less than three inches long, usually twisted
               7. Leaves up to 1 1/2 inches long; sheath at base of leaves not longer than 1/8 inch *Pinus banksiana*
               7. Leaves two to three inches long; sheath at base of leaves at least 1/3 inch long *Pinus sylvestris*
            6. Most or all leaves longer than three inches, rarely twisted
               8. Leaves mostly less than five inches long; cone-scale with a small spine *Pinus echinata*
               8. Leaves mostly more than five inches long; cone-scale without a spine *Pinus resinosa*
         5. Leaves in clusters of three
            9. Leaves flexible, mostly less than five inches long; sheath at base of leaves about ¼ inch long *Pinus echinata*
            9. Leaves stiff, mostly more than five inches long; sheath at base of leaves about one inch long *Pinus taeda*
1. Leaves solitary
   10. Leaves evergreen, of two types, some of them scale-like and about 1/8 inch long, some of them needle-like and up to 1/3 inch long *Juniperus virginiana*
   10. Leaves falling off in autumn, all needle-like, usually at least 1/2 inch long
      11. Leaves three-angled
         12. Leaves blue-green *Larix laricina*
         12. Leaves bright green *Larix decidua*
      11. Leaves flat *Taxodium distichum*

For additional listings, refer to reference *Forest Trees of Illinois*.

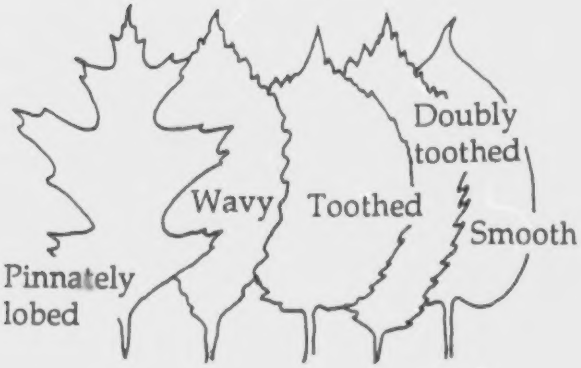
TRANSPARENCY MASTER #1

Leaf Edges, Tips, and Bases

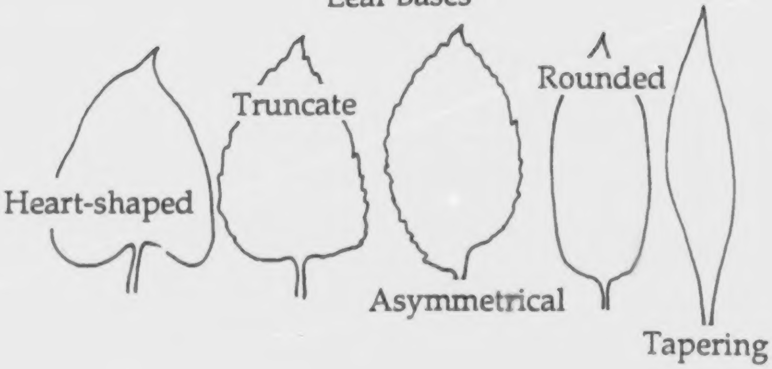
Leaf Tips


Acute
Obtuse
Long-tapering

Leaf Edges

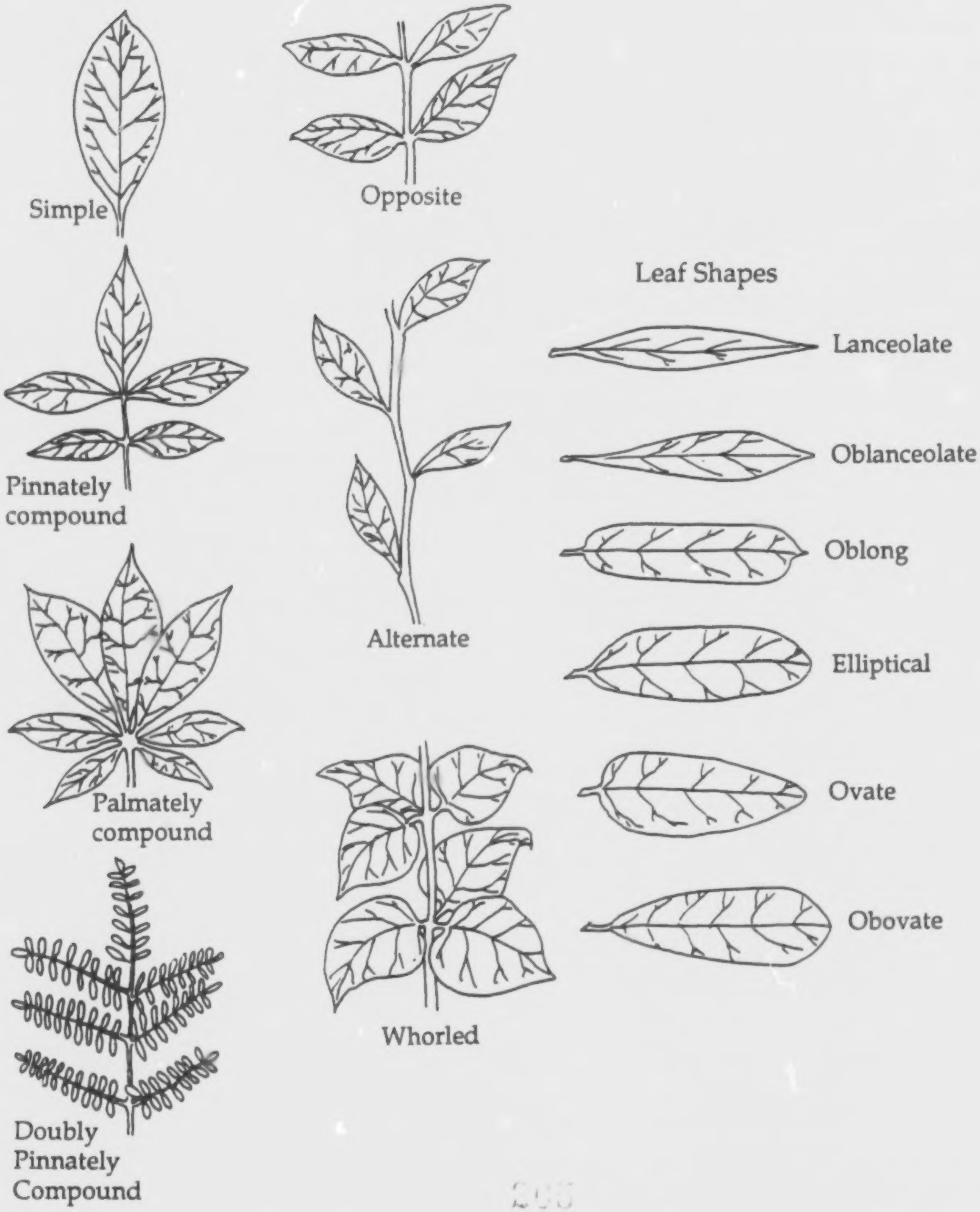

Pinnately lobed
Wavy
Toothed
Doubly toothed
Smooth

Leaf Bases


Heart-shaped
Truncate
Asymmetrical
Rounded
Tapering

TRANSPARENCY MASTER #2

Leaf Forms and Arrangements


Simple
Opposite
Pinnately compound
Alternate
Leaf Shapes
Lanceolate
Oblanceolate
Oblong
Elliptical
Palmately compound
Ovate
Obovate
Whorled
Doubly Pinnately Compound

STUDENT ACTIVITIES

STUDENT WORKSHEET #1 — Classification of Plants

STUDENT WORKSHEET #2 — Common and Scientific Names of Trees

For additional activities, teachers may refer to the "Suggested Teaching Activities and Procedures" section in the Instructor's Guide.

STUDENT WORKSHEET #1

Classification of Plants

1. Define the word taxonomy.

2. List three ways plants can be classified.

   a. ____
   b. ____
   c. ____

3. List five genera of trees common to Illinois.

   a. ____
   b. ____
   c. ____
   d. ____
   e. ____

4. Who invented the system of classification we use today?

5. Explain the difference between species and variety as they are used in our classification system.

6. Explain the difference between an Angiospermae and a Gymnospermae.

7. T or F All words are capitalized in tree classification except for the species and variety.

STUDENT WORKSHEET #2

Common and Scientific Names of Trees

Listed below are several trees by their common name. Next to the common name of the tree, write its scientific name.

1. Red Maple ____________________
2. Ohio Buckeye ____________________
3. Shagbark Hickory ____________________
4. Red Ash ____________________
5. Black Walnut ____________________
6. Prairie Crab Apple ____________________
7. Red Mulberry ____________________
8. White Pine ____________________
9. Bur Oak ____________________
10. Poison Sumac ____________________
11. Sandbar Willow ____________________
12. American Elm ____________________

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Forestry

PROBLEM AREA: Identifying Trees and Forestry Products

RELATED PROBLEM AREAS:

1. Managing Forestry Resources
2. Producing Christmas Trees
3. Processing Forest Products
4. Maintaining Wildlife Habitat
5. Managing Parks and Recreational Areas

PREREQUISITE PROBLEM AREA(S):

1. Classifying Trees
2. Conserving Agricultural Resources (Central Core Cluster)

LEVEL: Preparatory

OCCUPATIONAL TASKS ADDRESSED:

Agricultural Resources Cluster

Duty A: Managing the Recreational Facility

1. Assist in development of resource conservation plans

Duty D: Managing Facility Flora and Fauna

1. Identify plant communities and dominant species within a selected area
2. Identify native plant species within a selected area

Duty G: Assembling, Servicing, and Maintaining Equipment and Facilities

1. Report facility and grounds maintenance needs
2. Construct recreational equipment
3. Perform preventative and scheduled maintenance activities on grounds and facilities

STATE GOALS FOR LEARNING

In planning the instruction for this problem area, teachers can promote the development of several student learning objectives which are related to the State Goals for Learning in Biological and Physcial Sciences, Mathematics, and Social Sciences. These objectives are listed on the Learning Assessment Plan forms included on the following page(s). Those learning objectives marked with an asterisk (*) are taken from the sample lists provided by the Illinois State Board of Education.

Illinois Agricultural Core Curriculum

Agricultural Education 124 Mumford Hall 1301 W. Gregory Drive University of Illinois Urbana, IL 61801

Director: Dale A. Law, Ed.D.
Principal Investigator: Jerry D. Pepple, Ed.D
Research Assistant: Byron Mackey

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

Submission Date ____________
☐ Original submission ☐ Revision
Page ____ of ____

(Affix label or complete district information.)
COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐
District Name
City

I. LEARNING AREA *(check one)*
☐ Language Arts ☐ Fine Arts
☐ Mathematics ☐ Social Sciences
☒ Sciences ☐ Physical Development/Health

II. STATE GOAL FOR LEARNING
As a result of their schooling, students will have a working knowledge of the concepts and basic vocabulary of biological, physical, and environmental sciences and their application to life and work in contemporary technological society.

Contact Person: ____________
Title: ____________
Phone: (   )

III. LEARNING OBJECTIVES	IV. ASSESSMENT A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	V. EXPECTATIONS Percent of Students Expected to Achieve Objective
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:					
*1. Compare living organisms by applying a classification scheme.					
*2. Classify samples of matter by their characteristic physical and chemical properties.					
3. Define terms integral to identifying trees and forestry products.					
4. Describe the physical properties of wood.					
5. Select the proper species based upon identifying properties and characteristics.					

Identifying Trees and Forestry Products

Agricultural Resources
Forestry

211

212

Submission Date ____________

☐ Original submission ☐ Revision

Page _____ of _____

I. LEARNING AREA *(check one)*

☐ Language Arts ☐ Fine Arts

☐ Mathematics ☒ Social Sciences

☐ Sciences ☐ Physical Development/Health

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

(Affix label or complete district information.)

COUNTY	DISTRICT	ESC

District Name

City

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will be able to apply the skills and knowledge gained in the social sciences to decision making in life situations.

Contact Person: ____________

Title: ____________

Phone: (   )

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Understand the knowledge and skills required for success in selected fields of work.					
*2. Recognize that competence in a field of work entails the development of a wide range of skills.					
3. List the features used to identify species of trees.					
4. List common forestry products.					
5. Identify the originating species of common forestry products.					

ISBE 41-78 (1/88)

Illinois Agricultural Core Curriculum Rev.

ILLINOIS STATE BOARD OF EDUCATION
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LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

Submission Date ____________

☑ Original submission ☐ Revision

Page ____ of ____

(Affix label or complete district information.)

COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐

District Name

City

I. LEARNING AREA *(check one)*

☐ Language Arts
☒ Mathematics
☐ Sciences
☐ Fine Arts
☐ Social Sciences
☐ Physical Development/Health

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will be able to understand and use methods of data collection and analysis, including tables, charts, and comparisons.

Contact Person: ____________
Title: ____________
Phone: (   )

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Analyze data from an experiment.					

Identifying Trees and Forestry Products

Agricultural Resources
Forestry

ISBE 41-78 (1/88)

Submission Date ____________
☐ Original submission ☐ Revision
Page ____ of ____

I. LEARNING AREA *(check one)*
☐ Language Arts
☒ Mathematics
☐ Sciences
☐ Fine Arts
☐ Social Sciences
☐ Physical Development/Health

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

(Affix label or complete district information.)
COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐
District Name
City

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will be able to identify, analyze, and solve problems using algebraic equations, inequalities, functions, and their graphs.

Contact Person: ____________
Title: ____________
Phone: ( )

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Solve equations and inequations found in everyday life.					
*2. Apply formulas with and without calculators.					
217					
					218

ISBE 41 78 (1/88)

Identifying Trees and Forestry Products

Illinois Agricultural Core Curriculum Rev.

Agricultural Resources
Forestry

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Forestry

PROBLEM AREA: Identifying Trees and Forestry Products

STUDENT LEARNING OBJECTIVES

Upon completion of their study of this problem area, students will be able to:

1. Define terms integral to identifying trees and forestry products.
2. List the features used to identify species of trees.
3. Describe the physical properties of wood.
4. Select the proper species of tree based upon identifying properties and characteristics.
5. List common forestry products.
6. Identify the originating species of common forestry products.
7. Explain the properties of specific species of trees that make them suitable for specific uses.

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Forestry

PROBLEM AREA: Identifying Trees and Forestry Products

PROBLEMS AND QUESTIONS FOR STUDY

1. What characteristics can be used to identify trees?
2. How can leaves be used to identify trees?
3. How can twigs be used to identify trees?
4. How can bark be used to identify trees?
5. How can flowers be used to identify trees?
7. What are the physical characteristics of wood?
8. How can the physical characteristics be used to identify wood?
9. What are the physical properties of wood?
10. What are the physical properties of common softwoods?
11. What are the physical properties of common hardwoods?
12. What are some common commercially grown trees?
13. How are the commercially grown trees used?
14. What are some common products of wood?
15. What species are used for certain wood products?
16. What properties make certain trees useful as particular products?
17. Why are certain properties useful in certain products?

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Forestry

PROBLEM AREA: Identifying Trees and Forestry Products

SUGGESTED TEACHING ACTIVITIES AND PROCEDURES

1. Use the problem area *Applying Mathematics Skills in Agriculture* as a source of forestry problems for student practice.
2. Use the problem area *Identifying Basic Agricultural Mechanics Principles* as a resource for activities using forestry products.
3. Take a field trip in the local community to identify trees. Point out general characteristics of each particular species, how common the tree is, and some of the products made from the tree.
4. Have students look for similar characteristics between different species of trees. Have them make two lists of species dividing them between conifers and deciduous trees.
5. Assign each student a species of tree. Have them make a detailed listing of characteristics and how to identify that particular species of tree. Have them present this information to the class along with any steps on how to identify the tree.
6. Have students prepare an exhibit of leaves, twigs, seeds, bark, and wood samples of local species of forest trees. Include actual wood products or pictures of the products made from each species.
7. Have students do research to gather data on the temperature range, weather, growing season, topography, and soil types evidently preferred by the trees in the local area.
8. Have students do research into the economic importance of forestry industries in the state. Have them try to find out:
   a. The number and kind of wood-processing plants.
   b. The value of wood products produced annually.
   c. How the forest industries of the state rank in economic importance with others.
9. Have students make a map showing approximate locations of wood-processing plants in the state. Note relationships to rivers.
10. Have students do research on the size and uses of the state's forest lands.
11. Have students report on whether the nearest forested areas are classified as commercial or non-commercial. If commercial, list all products being produced (sawlogs for making lumber, pulpwood for making pulp for paper manufacture, veneer logs for making veneer and plywood, fuelwood, Christmas trees, Christmas greens, nuts, or other). List other forest benefits being provided by these commercial forests (conservation of soil, water, and wildlife, provision for recreation — hunting, fishing, camping, etc.). If non-commercial forests are present, list the forest benefits they provide.
12. Have students find the location of national and state forests and parks on a national map. Using paper strips and pins, have them identify the most important ones.
13. Have students report evidence they have seen in their community or elsewhere of the growing or harvesting of the leading commercial tree species in the area (logging operations, trucks, rail or water transportation of logs, forest tree nurseries, tree planting operations, aerial seeding or others).
14. If students have an opportunity to observe a building project in which lumber or plywood is being used — perhaps their own home — have them check on species being used and determine from the map its probable origin.
15. Plan a field trip to the nearest tree farm or other commercial forest area. Note species grown and find out from the owner their most probable destination and products which will be made from them. Ask the owner to explain his or her forestry practices and how they increase the productivity of his or her woodland.

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Forestry

PROBLEM AREA: Identifying Trees and Forestry Products

SUGGESTED TEACHING ACTIVITIES AND PROCEDURES (con't.)

INSTRUCTOR'S NOTES AND REFERENCES

16. Visit the nearest wood-processing plant (lumber mill, paper mill, veneer mill, wood distillation plant, naval stores plant, etc.). Find out if only local species of trees are being used. If not, learn the source and species of shipped-in raw material.

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Forestry

PROBLEM AREA: Identifying Trees and Forestry Products

REFERENCES

*1. *Forests and Forestry*. (1990). Holland, I.I., Rolfe, G.L., Anderson, D.A. Interstate Publishers, Inc., Box 50, Danville, IL 61834-0050. (217) 446-0500.

*2. *Plywood Applications in Farm Construction*, U3042; *Lumber: Grading, Selecting, Buying, Etc.*, U3055; *Lumber: Buying, Grading, Etc.*, T426; *Forest Tree Identification*. Vocational Agriculture Service, College of Agriculture, 1401 South Maryland Drive, Urbana, IL 61801.

3. *Forest Trees of Illinois.* Department of Conservation, 600 North Grand Avenue West, Springfield, IL 62706. (217) 782-7454.

4. *Fundamentals of Forestry*, #9654; *Tree Identification* (Video), #9655; *Practice Tree Identification*, #9656; *Teachers Handbook — Harvesting Forestry Products*, #0108. Instructional Materials Service, P.O. Box 2588, Texas A & M University, College Station, TX 77843-2588.

5. *Farm Your Forest*. (1989). 69C Mumford Hall, 1301 W. Gregory, Urbana, IL 61801. (217) 333-2007.

*Indicates highly recommended reference

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTIONAL RESOURCES

These resources are intended for use by teachers in planning and teaching the materials for this problem area and may be adapted to fit the teaching method(s) used.

INFORMATION SHEET #1 — Tree Identification

INFORMATION SHEET #2 — Guide to Tree Identification

INFORMATION SHEET #3 — Chart for Identifying Some Common Native and Introduced Forest Trees of Illinois in Summer - Broadleaved Species

INFORMATION SHEET #4 — Wood Identification

INFORMATION SHEET #5 — Physical Characteristics of Wood

INFORMATION SHEET #6 — Physical Properties of Wood

INFORMATION SHEET #7 — Chemical Properties of Wood

INFORMATION SHEET #8 — Properties of Some Common Woods

INFORMATION SHEET #9 — Commercial Trees and Their Uses

INFORMATION SHEET #10 — Forestry Products

TRANSPARENCY MASTER #1 — Features of Hardwood Twigs

TRANSPARENCY MASTER #2 — Leaves, Fruit, and Twigs of a Few Trees Which Compose the Central Hardwoods Forest Region

TRANSPARENCY MASTER #3 — Leaves, Fruit, and Twigs of Hardwood Trees Characteristic of the Northern Forest Region

TRANSPARENCY MASTER #4 — Cones and Leaves of Conifers Which Characterize the Northern Region

TRANSPARENCY MASTER #5 — Cones and Leaves of Important Timber Trees of the Western Part of the United States

TRANSPARENCY MASTER #6 — Common Types of Fruits and Seeds

TRANSPARENCY MASTER #7 — Porous and Non-Porous Wood

TRANSPARENCY MASTER #8 — Hardwood Structure

TRANSPARENCY MASTER #9 — Softwood Structure

TRANSPARENCY MASTER #10 — Forestry Products Derived from Commercial Tree Species

INFORMATION SHEET #1

Tree Identification

The most important characteristics to identify a tree are its leaves, fruit, twigs, and bark. Each kind of tree has certain characteristics which make it distinctive from other species.

Leaves — Most trees can be identified by type, size, shape, color, texture, and the arrangement of leaves. During the autumn and winter season, one must resort to other means of identification.

Twigs — Major characteristics of twigs used in identification are buds, leaf scars, lenticels, and bark. Some twigs have a distinctive color, smell, or taste. Except for a short period in the spring when buds formed during the previous season are opening and those for the present season have not appeared, twigs are a good means of identification.

Bark — Bark is the most important identification feature in the dormant winter period. Bark varies in thickness, roughness, type of fissures, and color. While these characteristics change with the increasing age of a tree, they remain a means of identification.

Fruit — Common types of fruit found on hardwood trees are listed below.

Simple Fruits — They consist of a single enlarged ovary with which some other flower parts may be incorporated.

A. Fleshy Fruits

1. Berry — The outer and inner walls are fleshy and enclose one or more seeds. Example — Persimmon tree.

2. Drupe (or stone fruit) — Fruit is one-seeded and fleshy. The outer part is fleshy while the inner part is stoney. Example — Black Cherry tree.

3. Pome — The outer portion of the fruit is fleshy while the inner portion is somewhat papery and forms a core containing numerous seeds. Example — Apple tree.

B. Dry Fruits

1. Dehiscent (those which pop open when ripe):

   a. Legume — Fruit with a true pod and one seed chamber which split along two sutures when ripe to discharge their seeds. Example — Mesquite tree.

   b. Capsule — Fruit with two or more chambers dehiscing along two or more sutures. Example — Catalpa tree.

2. Indehiscent (those which do not open when ripe):

   a. Achene — Fruit small, dry, one-seeded and unwinged, but often hairy. Example — Sycamore tree.

   b. Samara — Fruit a winged achene. Example — Maple tree.

   c. Nut — Fruit hard, usually one-seeded with a boney, woody, leathery, or papery wall and usually partly or entirely enclosed in an involucre or husk. Example — Walnut tree.

Compound Fruits — They consist of aggregate fruit or multiple fruit.

A. Aggregate fruit — Such fruit is a cluster of ripened fruits produced from a single flower containing numerous pistils inserted on a common receptacle. Example — Tulip tree.

B. Multiple fruit — Such fruit is a cluster of fruits of separate flowers crowded together and forming what appears to be a single fruit. Example — Hedge apples of Osage orange.

INFORMATION SHEET #2

Guide to Tree Identification

Trees With Evergreen Leaves

- Live Oak
- Southern Magnolia
- Red Bay
- American Holly
- Yaupon
- Huckleberry
- Baretta

Trees Which Produce Nuts

- The Walnuts
- The Hickories
- The Beeches
- Chinkapin
- The Oaks
- The Buckeyes
- Horse-chestnut
- The Chestnuts

Trees With Pods As Fruit

- Corkwood
- Texas Ebony
- Catclaw Acacia
- Leadtree (Mimosa)
- Mesquite
- Redbud
- Honeylocust
- Waterlocust
- Black Locust
- Catalpa
- Desert Willow
- Huisache (Sweet Acacia)
- Guajillo
- Coral Bean
- Mexican Leadtree
- Kentucky Coffee Tree

Trees With Bright Red Fruit

- Red Mulberry
- The Magnolias
- The Hawthorns
- Shining Sumac
- American Holly
- Flowering Dogwood

Trees With Soft Berrylike Fruit

- The Hackberries
- The Mulberries
- Osage orange (Bois d'Arc)
- Red Bay
- Sassafras
- The Hawthorns
- The Cherries and Plums
- American Holly
- Yaupon
- Black Gum and Tupelo
- Dogwood
- Tree Farkleberry (Tree Huckleberry)
- Gum Bumelia (Gum Elastic)
- Persimmon Fringe Tree
- Black Hawthorn
- Sourwood

Trees With Seeds Winged or With Parachutelike Attachments

- The Cottonwoods
- Black Willow
- American Hornbeam (Blue Beech)
- Ironwood
- River Birch
- The Elms
- Planetree
- Sweet Gum
- American Sycamore
- Hoptree
- The Maples
- The Basswoods
- Silverbell
- The Ashes
- Catalpa
- Desert Willow
- Buttonbush
- Alder
- Tree of Heaven
- Tulip Tree
- Ailanthus

Trees With Corky Projection on Twigs

- Bur Oak (Mossy-Cup Oak)
- Cedar Elm
- Winged Elm
- Sweet Gum

Trees With Flowers in Clusters

- Red Bay
- The Hawthorns
- The Plums and Cherries
- Redbud
- Black Locust
- Devil's-Walking-Stick
- Hercules'-Club
- Hoptree
- The Sumacs
- Poison Sumac
- Yaupon
- Ohio Buckeye
- Western Soapberry
- The Basswoods
- Flowering Dogwood
- Silverbell
- Fringe tree
- Catalpa
- Black Hawthorn
- Shadbush

Trees Whose Blossoms Appear Before or With the Leaves

- The Walnuts
- The Hickories
- The Cottonwoods
- Black Willow
- Ironwood
- Eastern Hophornbeam
- River Birch
- The Elms
- Sassafras
- Redbud
- The Maples
- The Ashes
- Alder
- Shadbush

Trees With Spines or Thorns

Osage orange (Bois d'Arc)
The Hawthorns
Texas Ebony
Catclaw Acacia
Leadtree (Mimosa)
Mesquite
Honey Locust
Water Locust
Black Locust
Prickly Ash
Devil's-Walking-Stick
Huisache (Sweet Acacia)
Wild Plums
Wild Crab Apple

Trees Whose Blossoms Appear After the Leaves

Chinkapin
Magnolia
Honey Locust
Black Locust
The Sumacs
Ohio Buckeye
Flowering Dogwood
Persimmon
Silverbell
Fringe Tree
Catalpa
Mountain Maple
Horse Chestnut
Mountain Ash
Sourwood

Trees Whose Leaves Turn Red in Autumn

Red Oak
Sweet Gum
The Hawthorns
The Sumacs
Red Maple
Black Gum
Flowering Dogwood
Sugar Maple (yellow as well)
Scarlet Oak

Trees Whose Leaves Turn Yellow in Autumn

The Hickories
The Cottonwoods
Black Willow
Hornbeam (Blue Beech)
River Birch
Most of the Oaks (except Red Oak)
Osage orange (Bois d'Arc)
Southern Magnolia
Pawpaw
Mesquite
Redbud
Hercules'-Club
Red Maple
Ohio Buckeye
Devil's-Walking-Stick
The Ashes
Fringe Tree
Catalpa
Sugar Maple (red as well)

Trees That Prefer Wet Sites

Bald Cypress
Water Hickory
Corkwood
Cottonwood
Black Willow
Blue Beech (Hornbeam)
Ironwood (Hophornbeam)
Red Birch (River Birch)
Water Oak
Willow Oak
Bur Oak
Overcup Oak
Swamp Chestnut Oak
Sweet Bay
Sweet Gum
The Hawthorns
Water Locust
Poison Sumac
Yaupon
Black Gum (Black Tupelo)
Tupelo (Water Tupelo)
Water Ash
Swamp Privet
Alder

Trees With Single Large Flowers

Magnolia
Pawpaw

Trees Whose Twigs Have a Chambered Pith

Walnut
Sugarberry
Hackberry

Trees Known by the Color and Shape of the Twig Pith

Star-shaped in Cross Section

The Cottonwoods
The Oaks
Chestnut
Aspen

Triangular in Cross Section

Alder

Brown in Color

The Walnuts
The Sumacs
Mountain Maple
Striped Maple

Red in Color

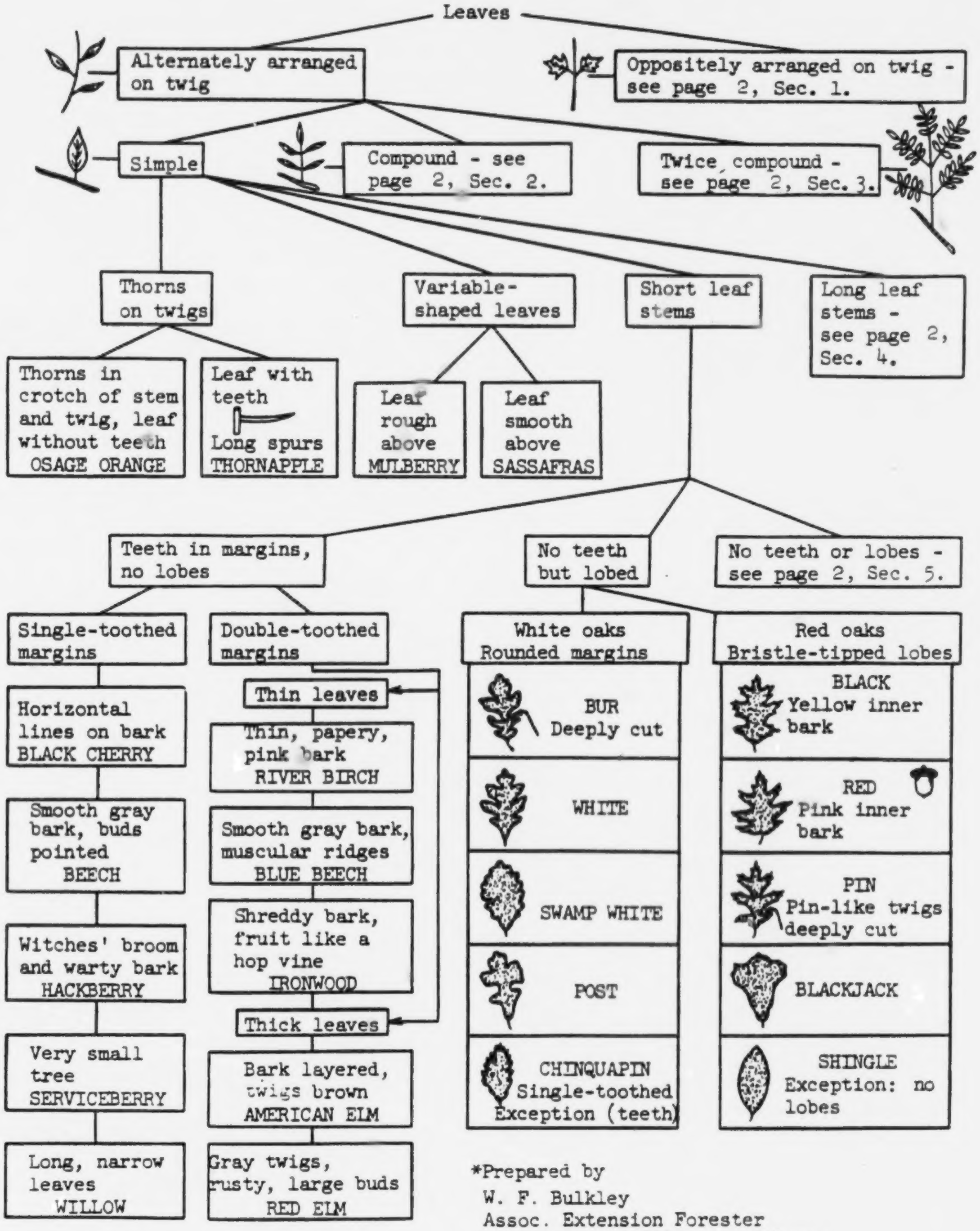
Kentucky Coffee Tree

Greenish in Color

Shadbush

INFORMATION SHEET #3

CHART FOR IDENTIFYING SOME COMMON NATIVE AND INTRODUCED FOREST TREES OF ILLINOIS IN SUMMER - BROADLEAVED SPECIES*


Leaves
Alternately arranged on twig
Oppositely arranged on twig - see page 2, Sec. 1.
Simple
Compound - see page 2, Sec. 2.
Twice compound - see page 2, Sec. 3.
Thorns on twigs
Variable-shaped leaves
Short leaf stems
Long leaf stems - see page 2, Sec. 4.
Thorns in crotch of stem and twig, leaf without teeth OSAGE ORANGE
Leaf with teeth Long spurs THORNAPPLE
Leaf rough above MULBERRY
Leaf smooth above SASSAFRAS
Teeth in margins, no lobes
No teeth but lobed
No teeth or lobes - see page 2, Sec. 5.
Single-toothed margins
Double-toothed margins
White oaks Rounded margins
Red oaks Bristle-tipped lobes
Horizontal lines on bark BLACK CHERRY
Smooth gray bark, buds pointed BEECH
Witches' broom and warty bark HACKBERRY
Very small tree SERVICEBERRY
Long, narrow leaves WILLOW
Thin leaves
Thin, papery, pink bark RIVER BIRCH
Smooth gray bark, muscular ridges BLUE BEECH
Shreddy bark, fruit like a hop vine IRONWOOD
Thick leaves
Bark layered, twigs brown AMERICAN ELM
Gray twigs, rusty, large buds RED ELM
BUR Deeply cut
WHITE
SWAMP WHITE
POST
CHINQUAPIN Single-toothed Exception (teeth)
BLACK Yellow inner bark
RED Pink inner bark
PIN Pin-like twigs deeply cut
BLACKJACK
SHINGLE Exception: no lobes

*Prepared by
W. F. Bulkley
Assoc. Extension Forester
University of Illinois, Urbana

IDENTIFICATION CHART - BROADLEAVED SPECIES (CONTINUED)

Section 1.--Leaves Oppositely Arranged on Twig

- Simple
  - Lobed
    - Rounded leaf crotches SUGAR MAPLE
    - Sharp leaf crotches SILVER MAPLE
  - No lobes
    - Heart-shaped leaf CATALPA
    - Oval-shaped leaf FLOWERING DOGWOOD
- Compound
  - 3 to 5 leaflets, green twigs BOXELDER
  - 5 leaflets attached at one point BUCKEYE
  - 7 or more leaflets, canoe-paddle seed ASHES

Section 2.--Leaves Alternately Arranged on Twig and Compound

Number of leaflets

- 5 Shaggy bark SHAGBARK HICKORY
- 5 to 7 Little buds PIGNUT HICKORY
- 7 to 9 Big buds, wavy bark MOCKERNUT HICKORY
- 7 to 9 Yellow buds BITTERNUT HICKORY
- 7 to 17 Short thorns BLACK LOCUST
- 13 to 23 Chocolate-colored bark BLACK WALNUT
- 13 to 41 Gray bark AILANTHUS (Heaven tree)

Section 3.--Leaves Alternately Arranged on Twig, Twice Compound

- Long-branched thorns or spurs on twigs and trunk, some leaves once compound HONEY LOCUST
- No thorns, twigs with mottled colored branches, leaves one to three feet long COFFEETREE

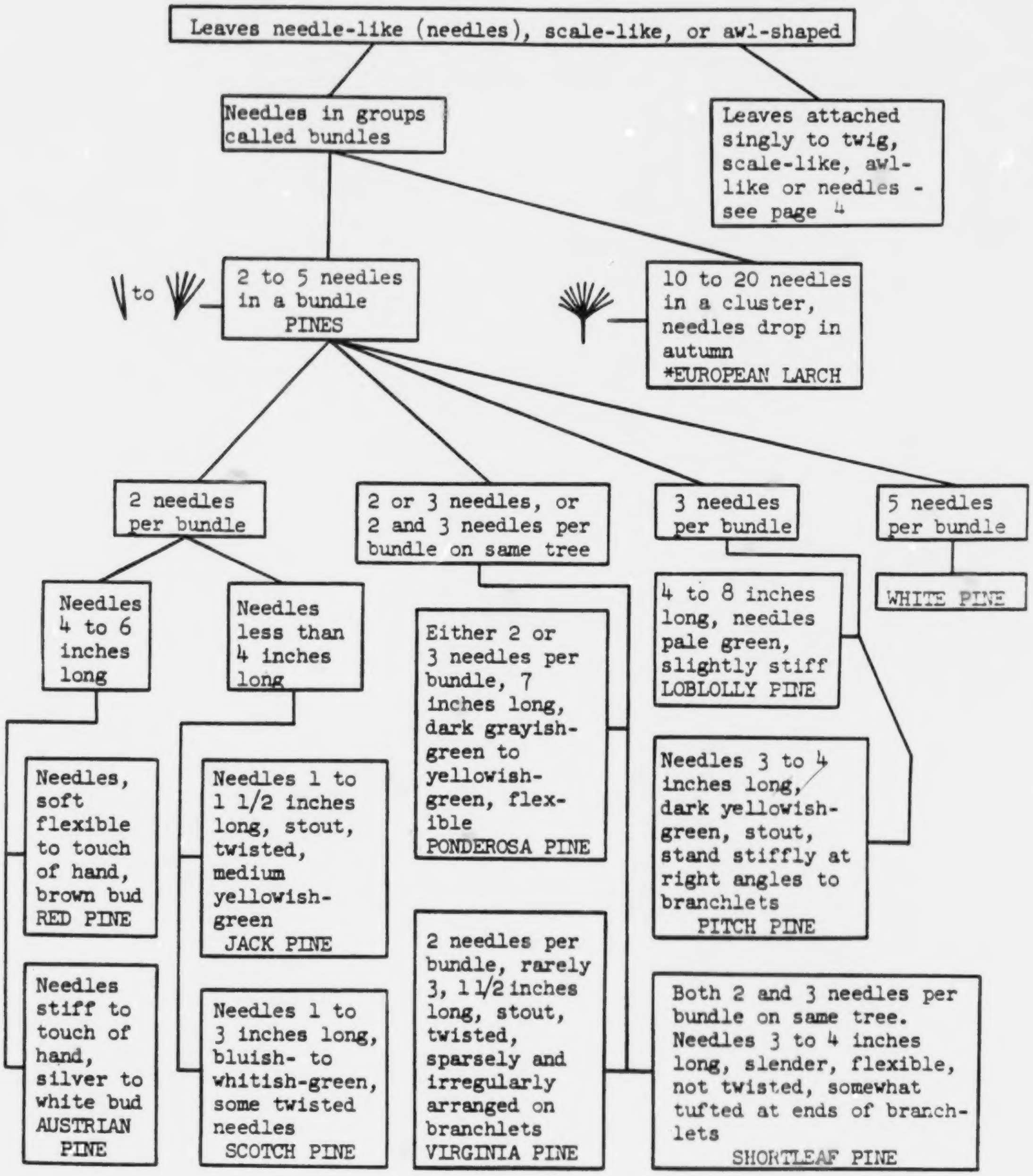
Section 4.--Leaves Alternately Arranged on Twig, Simple Long Leaf Stems

- Flat stems
  - Thick stems, delta-shaped leaves COTTONWOOD
  - Thin stems, circular shaped leaves ASPEN
- Rounded stems
  - Clasps on leaf stems
    - Base of leaf stem swollen SYCAMORE
    - Top of leaf notched TULIPTREE
  - No clasps on leaf stems
    - Star-shaped leaves RED GUM
    - Both ends of leaf stems swollen REDBUD
    - Heart-shaped leaf, seed on wing BASSWOOD

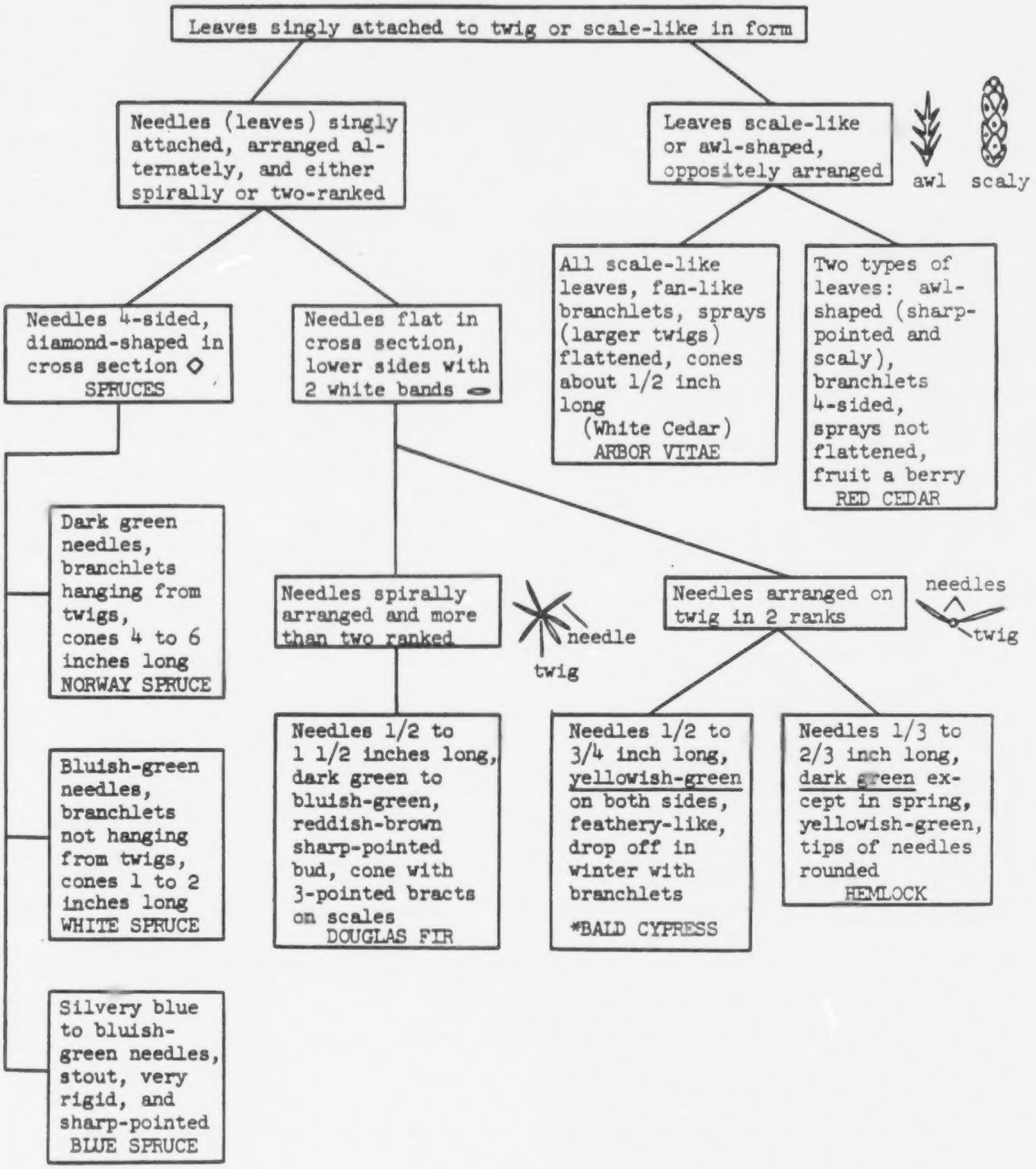
Section 5.--Leaves Alternately Arranged on Twig, Simple, Short Stems and No Teeth or Lobes

- Oval-shaped
  - Bark with small squares, deeply furrowed, plum-like fruit, generally small tree. Central and southern Illinois PERSIMMON
  - See red oaks. Bark thin with shallow furrows, fruit an acorn SHINGLE OAK
- Broader near tip than at base
  - Bark with oblong blocks, also deeply furrowed, alligator-like skin, fruit in 2's or 3's, 1/3 inch long, large tree BLACK GUM

CHART FOR IDENTIFYING CONIFEROUS FOREST TREES PLANTED IN ILLINOIS - ALL EVERGREEN EXCEPT ONE*


Leaves needle-like (needles), scale-like, or awl-shaped
Needles in groups called bundles
Leaves attached singly to twig, scale-like, awl-like or needles - see page 4
to
2 to 5 needles in a bundle PINES
10 to 20 needles in a cluster, needles drop in autumn *EUROPEAN LARCH
2 needles per bundle
2 or 3 needles, or 2 and 3 needles per bundle on same tree
3 needles per bundle
5 needles per bundle
WHITE PINE
Needles 4 to 6 inches long
Needles less than 4 inches long
Either 2 or 3 needles per bundle, 7 inches long, dark grayish-green to yellowish-green, flexible PONDEROSA PINE
4 to 8 inches long, needles pale green, slightly stiff LOBLOLLY PINE
Needles, soft flexible to touch of hand, brown bud RED PINE
Needles 1 to 1 1/2 inches long, stout, twisted, medium yellowish-green JACK PINE
Needles 3 to 4 inches long, dark yellowish-green, stout, stand stiffly at right angles to branchlets PITCH PINE
Needles stiff to touch of hand, silver to white bud AUSTRIAN PINE
Needles 1 to 3 inches long, bluish- to whitish-green, some twisted needles SCOTCH PINE
2 needles per bundle, rarely 3, 1 1/2 inches long, stout, twisted, sparsely and irregularly arranged on branchlets VIRGINIA PINE
Both 2 and 3 needles per bundle on same tree. Needles 3 to 4 inches long, slender, flexible, not twisted, somewhat tufted at ends of branchlets SHORTLEAF PINE

IDENTIFICATION CHART - CONIFEROUS TREES (CONTINUED)
ONE TREE DECIDUOUS*



- Leaves singly attached to twig or scale-like in form
  - Needles (leaves) singly attached, arranged alternately, and either spirally or two-ranked
    - Needles 4-sided, diamond-shaped in cross section ◇ SPRUCES
      - Dark green needles, branchlets hanging from twigs, cones 4 to 6 inches long NORWAY SPRUCE
      - Bluish-green needles, branchlets not hanging from twigs, cones 1 to 2 inches long WHITE SPRUCE
      - Silvery blue to bluish-green needles, stout, very rigid, and sharp-pointed BLUE SPRUCE
    - Needles flat in cross section, lower sides with 2 white bands
      - Needles spirally arranged and more than two ranked
        - Needles 1/2 to 1 1/2 inches long, dark green to bluish-green, reddish-brown sharp-pointed bud, cone with 3-pointed bracts on scales DOUGLAS FIR
      - Needles arranged on twig in 2 ranks
        - Needles 1/2 to 3/4 inch long, yellowish-green on both sides, feathery-like, drop off in winter with branchlets *BALD CYPRESS
        - Needles 1/3 to 2/3 inch long, dark green except in spring, yellowish-green, tips of needles rounded HEMLOCK
  - Leaves scale-like or awl-shaped, oppositely arranged
    - All scale-like leaves, fan-like branchlets, sprays (larger twigs) flattened, cones about 1/2 inch long (White Cedar) ARBOR VITAE
    - Two types of leaves: awl-shaped (sharp-pointed and scaly), branchlets 4-sided, sprays not flattened, fruit a berry RED CEDAR

INFORMATION SHEET #4

Wood Identification

In order for persons to identify wood, they must become familiar with the general appearances and differences of the different species. Some woods, as black walnut, have a distinctive color. Cypress, sassafras, and cedar can be distinguished by their odor. Some woods have a pronounced difference in color between the heartwood and sapwood while in others there is no difference. Pitch is found in pine wood. Pores in wood are an important means to aid in wood identification.

Wood can be identified as a hardwood or softwood by the presence or absence of pores when viewed in a transverse section. (See Transparency Masters #8 and #9) If pores are not present, it is a softwood. Pines show small, fairly evenly distributed openings called resin ducts on a transverse surface. Resin ducts should not be confused with the pores noted in hardwoods, since the pores in hardwood are closer together than are resin ducts.

When a conifer wood sample (refer to Transparency Master #9) is viewed from the top, in transverse section, tracheids, or water carriers, form the bulk of the wood surface. Between the various cells is a cementing substance called the middle lamella. Springwood cells are distinguishable by their larger size, in contrast to the summerwood cells. Together the springwood and summerwood cells make up the annual ring. One such ring is added annually to the outside of a tree.

When the wood is viewed in a vertical plane, medullary rays will be visible. The function of the rays is to store and distribute food material of the tree horizontally. The rays are of two types, fusiform medullary rays and rays with horizontal resin ducts.

The surface of the wood is commonly called edge grain in softwoods and quarter sawn in hardwoods. It is not so distinctive in softwoods however, as it is in most hardwoods.

Simple pits are unthickened portions of cell walls through which sap passes from ray cells to fibers or vice versa. Bordered pits on the surface have their margins overhung by the surrounding cell walls. The surface at right angles to the radial or quartersawn surface corresponds to the flat grain or plain-sawn surface of lumber.

To examine the cell structure of hardwood refer to Transparency Master #8. The horizontal plane corresponds to the end surface of a log. The vertical plane corresponds to a surface cut parallel to the radius, while the vertical represents a surface cut at right angles to the radius. Hardwoods may be cut at a sawmill in these three planes and are known, respectively, as end grain, quartersawn and plain-sawn surfaces.

Hardwoods have specialized vessels or pores for conducting sap. In softwoods, fibers are used to transfer sap. Hardwood vessels are relatively large cells with open ends, one above the other and continuing as open passages for long distances. In the heartwood and sapwood of some species, the pores are filled with tyloses.

Pores of hardwoods vary in size. In some, they are visible to the naked eye. In most of the hardwoods the ends of the individual cells of the pores are open, while in others they may be separated by a grating.

The strength-giving elements of hardwood are wood fibers. Usually they have small cavities and thick walls. In the fiber walls are found pits by which sap passes from one cavity to another. Medullary rays are short horizontal cells which extend in a radial direction and serve to store food and distribute it horizontally. In the magnified black oak, the surface cells are shown as being two cells wide. However, in some hardwood species the width may vary, some having over 50 cells.

In temperate climates the annual ring is usually sharply defined. Generally, wood formed in the spring, or springwood, is more porous than the summerwood.

All wood cells, including pores, fibers, ray cells, etc., are cemented together by what is called, technically, the middle lamella. By the use of certain chemicals, this layer can be dissolved, permitting the fibers to be separated. This process is used in paper making.

INFORMATION SHEET #5

Physical Characteristics of Wood

Porous and Non-Porous Woods

The wood of trees is divided into two major groups:

A. Non-Porous — Examples:

   1. Cedar
   2. Fir
   3. Spruce
   4. Pine
   5. Larch

B. Porous

   1. Diffuse-Porous — Examples:
      a. Basswoods
      b. Beeches
      c. Maples
      d. Birches
      e. Black Walnuts

   2. Ring-Porous — Examples:
      a. Ash
      b. White Oaks
      c. Hickories
      d. Elms
      e. Red Oaks

In ring-porous woods, larger pores are found in the springwood and smaller pores in the summerwood. In diffuse-porous woods, the pores are rather small and evenly scattered throughout the summerwood and springwood. (Refer to Transparency Master #7.)

Weight and Strength

The weight of wood is expressed in terms of its specific gravity or weight per cubic or thousand board feet. If the specific gravity of a wood is expressed as 0.51, it means that a given volume of this wood weighs 0.51 times as much as an equal volume of water. Since a cubic foot of water weighs 62.5 pounds, a cubic foot of wood of the species with a specific gravity of 0.51 would weight 0.51 x 62.5, or 32 pounds. Specific gravity of wood is influenced to a large degree by the amount of gum, resins, and other extractives, size of cell cavities and thickness of cell walls. Specific gravity of a few commercial species are listed below.

	Specific Gravity	
Species	Green	Air-Dry
Red Maple	.49	.54
White Oak	.59	.67
Loblolly Pine	.47	.51
Ponderosa Pine	.38	.40

Bending

For certain uses such as in manufacturing, it is necessary to bend wood. Some hardwoods are more readily softened by heat and moisture for this purpose than are others. Elms, ashes, and pecan hickories are preferred where extreme bending is required. Oaks, birches, beeches, red gum, and maples are also used for bent parts where moderate bending is required. Southern pine can be used for minimum bends only.

A variety of chemicals are used to aid in the bending of wood. Among them are urea, dimethyl sulfoxide, and liquid ammonia.

Additional Information

Resin canals are found in pine. These are intercellular passages surrounded by secreting cells and are often filled with resin.

Properties such as color, luster, taste, hardness, odor, and texture are important considerations in wood identification. To the wood user weight, strength, stiffness, bending and woodworking qualities, hardness, toughness, ability to be strained, and shrinkage are among the most important.

In hardwoods the hardwood fibers are about 1/25 of an inch in length. In contrast, softwood fibers range from about 1/8 to 1/3 of an inch. Length of fibers has no direct effect on the strength of wood. Most important are the thickness and structure of the fiber walls.

There is no consistent difference, either in the weight when dry, or in the strength of sapwood and heartwood of hardwoods.

The width of annual rings does affect the weight and strength of wood in species that are ring-porous. Normally, increased growth increases the strength of the wood. As such, second-growth ring-porous trees are somewhat stronger than virgin-growth hardwoods.

Southern pine wood decreases in strength with an increase in growth rate. Trees with wide annual rings are weaker, and for this reason a forest landowner should strive for uniform growth of trees to produce the best lumber.

INFORMATION SHEET #6

Physical Properties of Wood

Physical properties of wood include:

1. Color.
2. Luster.
3. Odor and taste.
4. Grain and texture.
5. Weight.
6. Hardness.

Species Identification:

Black Walnut — Dark brown in color and hard, used for cabinets.

Coast Redwood — Rose color on end cut, old wood grey, reddest of woods, sapwood sharp white, never has pecky heartrot.

Douglas Fir — Reddish color, some white, heaviness and fairly hard soft wood, may have timber breaks.

Maple — White and very hard.

Ponderosa Pine — End grain has sharp difference between spring and summer wood, moderately soft.

Sugar Pine — Difference between spring and summer rings not sharp, resin canals form flecks, sweet smell, may have blue stain, used for window and door sashes.

White Ash — Real luster, white color, hardwood.

White Fir — Quite soft in color, softer than Douglas Fir or Ponderosa Pine, pronounced annual rings.

White Oak — White in color, flecks, hardwood, good rays.

Features Important in Identification:

1. Planes of study:
    a. Transverse — Cross section viewed from end of log.
    b. Radial — View when cross section cut along radius across growth rings.
    c. Tangential — Exposed when bark removed.
2. Growth increments (annual rings produced from cambium):
    a. Width of hands indicates rate of growth.
    b. Varies with species.

INFORMATION SHEET #7

Chemical Properties of Wood

Wood is made up of about 50 percent cellulose, 28 percent lignin, and minor quantities of other materials. Less lignin occurs in hardwoods than in softwoods. Cellulose forms the framework of the cell wall and is the product used in the manufacture of paper. Lignin is the cementing material that binds the cells together and is also found mixed with cellulose in the cell walls. When the lignin is dissolved with chemicals, the cells may be separated for paper making. Cellulose and lignin are responsible for some differences in the properties of wood, such as the ability to absorb moisture and resistance to corrosion by salt water. Characteristics such as color, odor, and natural resistance to decay cannot be attributed to cellulose or lignin, but rather to other materials in the wood.

INFORMATION SHEET #8

Properties of Some Common Woods

	Working and Behavior Characteristics						Strength Properties			
	Hardness	Ease of working	Paint holding	Nail holding	Decay resistance of heartwood	Freedom from odor and taste (dry)	Bending strength	Stiffness	Strength as post	Toughness
Ash, White	A	C	-	A	C	A	A	A	A	A
Bald cypress	B	B	A	B	A	B	B	B	B	B
Basswood	C	A	-	C	C	A	C	B	C	C
Beech	A	C	-	A	C	A	A	A	B	A
Birch, Yellow	A	C	-	A	C	A	A	A	B	A
Cherry	A	C	-	-	-	B	A	A	A	B
Cottonwood	C	B	-	C	C	B	C	B	C	B
Cypress	B	B	A	B	A	B	B	B	B	B
Douglas fir	B	C	C	B	B	C	A	A	A	B
Elm, Rock	A	C	-	-	B	A	A	A	B	A
Elm, Soft	A	C	-	A	B	A	B	B	B	A
Fir, Balsam	C	B	B	-	C	A	C	C	C	C
Fir, White	C	B	B	C	C	A	B	B	B	C
Hackberry	A	C	-	-	-	A	B	C	C	A
Hemlock, Eastern	B	B	B	B	C	A	B	B	B	B
Hemlock, Western	B	B	B	B	C	A	B	A	B	B
Hickory, Pecan	A	C	-	-	C	-	A	A	A	A
Hickory, True	A	C	-	A	C	-	A	A	A	A
Junipers	C	A	A	C	A	C	C	C	C	C
Larch, Western	A	C	C	A	B	C	A	A	A	B
Locust, Black	A	C	-	A	A	B	A	A	A	A
Magnolia	B	A	A	A	-	C	B	B	C	C
Maple, Hard	A	C	-	A	C	A	A	A	A	A
Maple, Soft	A	C	-	A	C	A	C	C	C	C
Mesquite	A	-	-	-	A	-	-	-	-	-
Oak, Red	A	C	-	A	C	-	A	A	B	A
Oak, White	A	C	-	A	A	-	A	A	B	A
Pine, Eastern White	C	A	A	B	-	C	C	C	C	C
Pine, Ponderosa	C	A	B	B	-	C	C	C	C	C
Pine, Southern Yellow	A	C	C	A	B	C	A	A	A	B
Pine, Sugar	C	A	A	-	-	C	C	C	C	C
Pine, Western White	C	A	A	B	-	C	B	B	B	B
Red Cedar, Eastern	A	B	-	-	A	C	B	C	A	B
Red Cedar, Western	C	A	A	C	A	C	C	C	B	C
Red gum	B	B	-	B	B	B	B	B	B	B
Redwood	B	B	A	B	A	-	B	B	A	B
Spruce, Eastern	C	B	B	B	C	A	B	B	B	B
Sweet gum	B	B	-	B	B	B	B	B	B	B
Sycamore	A	C	-	A	C	-	B	B	B	B
Tupelo	A	C	-	A	C	A	B	B	B	B
Walnut	A	B	-	-	A	-	A	A	A	A
Willow	C	A	-	-	C	C	C	C	C	C
Yellow poplar	C	A	-	B	C	A	B	B	C	C

A: Relative high value in the particular property listed; B: Medium value in the particular property listed; C: Relative low value in the particular property listed.

(Courtesy United States Forest Products Laboratory)

INFORMATION SHEET #9

Commercial Trees and Their Uses

Wood is a renewable resource and is the most widely used construction material in the nation. Lumber, plywood, and pulp are the principal products derived from wood. However, many other products are derived from trees. Some of the many uses of trees along with the species are as follows.

Southern Pine — The name southern pine is applied in the lumber trade to include shortleaf, loblolly, slash, and longleaf pine. Equally common is the term yellow pine as it is applied to these species, being derived from the yellowish color of the wood.

Longleaf derived its name from the needles which are longer than those of other pine species. Its wood is one of strength, toughness, durability, and resiliency.

Slash pine, like longleaf pine, has the ability to produce turpentine and resin.

Shortleaf pine has a long taproot which enables a tree to obtain water at considerable depth below the surface of the ground.

Loblolly pine is frequently referred to as "old field pine" since it is commonly found in abandoned fields. It grows faster than either longleaf or shortleaf pine, but not so fast as slash pine during the first 20 years. Beyond this age, loblolly shows the greatest growth. Wood produced from shortleaf and loblolly pine ranges from dense to soft texture, making it suitable for many uses.

Southern pine lumber is used for a wide range of purposes, as in heavy structural and light framing interior finish, flooring, sheathing, crates, boxes, railroad cars, and for many more industrial purposes. About 15 percent of the annual production goes into dimension material and other items sold by retail lumber yards.

The wood of southern pine takes preservative treatment readily and is used extensively for poles, piling, fence posts, cross ties, treated foundation timbers, and other construction materials.

Ash — Of the seven commercially valuable species of ash, six are sold under the name white ash. Two of these species, white ash and green ash, together make up over three-fourths of the annual cut. The wood is slightly lighter in color than oak, with the exception of having no visible medullary rays. The sapwood is nearly white; the heartwood is pale brown. The wood possesses high-strength properties for its weight. In the area of sports, ash is indispensable. Baseball bats, polo and hockey sticks, playground equipment, skis, and tennis rackets are but a few of the many items made. Ash is also recognized as the best wood for handles for such things as shovels and rakes. It has many other uses, such as in trim, doors and other woodwork. It has extensive use in bent wood parts, as it responds to steam bending.

Beech — One characteristic of beech is its slow growth. The wood of beech is hard, dense and light in color. It has a diffuse-porous structure and numerous pith or medullary rays. The sapwood is pale flesh while the heartwood is a reddish color. Flooring is the most important product made from beech. Beech is also used extensively by the furniture and brush industries. Other major uses include truck body parts, toys, woodenware, and novelties.

Cottonwood — Cottonwood is a rapid growing tree which thrives in rich bottomlands and flood plains. The wood is soft-textured and light in weight. It has an especially long fiber which makes it strong and tough for its weight. Cottonwood sapwood is generally very white. Principal uses include shipping containers, paper production, furniture, agricultural implements, and veneer. It is used also for excelsior and in the manufacture of matches.

INFORMATION SHEET #10

Forestry Products

Each individual timber product has its own specifications. Generally the higher the value of the product, the more stringent or limiting are the specifications; for example, in the case of softwood, the acceptable limits for pulpwood are quite broad, whereas those for poles and piling are quite narrow. With hardwood, the range of material suitable to make railroad crossties is very wide, while that suitable for veneer bolts is very narrow.

Pulpwood — Virtually all softwoods and hardwoods are now acceptable to pulp and paper mills. A few firms specify particular species. Practically all species of hardwood are purchased by some mills; but volumes are sometimes limited, especially for the hard hardwoods such as the oaks.

Minimum-sized pulptimber trees are five inches in diameter at breast height (dbh). Generally, these trees are too small to yield enough pulpwood to justify cutting. A practical minimum is more like a seven-inch dbh. The trees must be sound and unburned.

No two pulp and paper mills or U.S. regions have identical pulpwood specifications. Some generalized pulpwood specifications include:

1. Pulpwood is classified as shortwood if under 120 inches in length and longwood if over 120 inches long. Some general lengths by regions are 48 inches in the Northeast; varying lenghts from 48 inches to 64 inches in the South; 100 inches in the Lake States; and 90 inches in the West. Some paper mills purchase tree length pulpwood.

2. Minimum softwood diameter at the small end measured inside the back must not be less than four inches, although a few smaller sticks are allowed by some mills. Minimum hardwood diameters are usually five inches. Generally, no maximum diameters exist, but a few mills have specified upper limits.

3. All trees must be sawed and limbs trimmed close to the surface of the stick.

4. Sticks must be cut from sound, live trees free from charred or pitch wood and metal.

Fence Posts — Like pulpwood, fence posts provide good outlets for small timber, especially for that cut in the thinning of softwood plantations. Pines are the preferred species because of the ease of treatment with preservatives, but some hardwoods, such as sweet gum, are finding increasing use. Trees used for fence posts must be reasonably straight and the wood fairly dense for adequate post strength. Minimum tree size is five inches dbh, but generally posts are harvested from larger timber. The sizes are designated by the top diameter and usually run from two and a half inches to eight inches, diameter inside bark. Post lengths generally run from five to eight feet.

Mine Timbers — Some limited markets are still available for timber used in mines as supports in the construction of tunnels, shafts, openings and chambers. Hardwoods, principally oak, and the southern pines are the main species used. The species used must be high in bending and column strength. Some material is sawn and some used as round timbers.

Mine timbers are usually taken down to four-inch diameters. This provides an outlet for small-sized and short length timber. It is a low-valued product receiving minimum prices. A considerable volume of mine timbers is exported to Mexico.

Railroad Crossties — The demand for railroad crossties, used to support the steel track, has continued to be good in recent years. Only a few ties are still hewn; that is, cut into rectangular shapes with an adze or large axe. Most ties are sawn in small portable sawmills. Ties are produced principally from low-grade hardwood because the higher grades of it and pine have become too valuable and are used for saw timber.

Larger-sized, low-grade southern pine, Douglas fir and other softwoods and virtually all species of low-grade hardwood, such as oaks and gums, are suitable for ties. Generally, trees not suitable for other uses are best sold for this product. In recent years sawn crosstie prices have increased appreciably. Minimum-sized trees are those suitable for sawtimber, that is, nine inches dbh.

Railroad ties are produced in rectangular shapes in sizes from six by seven inches to seven by nine inches. Lengths vary from six-and-a-half-foot narrow gauge ties to eight- or eight-and-a-half- and nine-foot standard gauge ties. Most ties are pressure treated with coal-tar creosote to increase their service life.

Sawtimber — Sawtimber trees are generally those cut into sawlogs to produce lumber, veneer, and plywood. Sawtimber trees are usually at least eight inches dbh, but generally are of larger diameter. Sawtimber values, however, vary greatly with species and size. A 16-inch, three 16-foot log tree will scale about ten times as many board feet as a ten-inch, one 16-foot log tree, and the grace and value of the logs will be much higher.

Markets exist for high-quality hardwood sawtimber to be used to make cooperage for barrels, baskets, and boxes. Cooperage material includes top quality white oak, cow oak, overcup oak, and post oak. Basket and box industries utilize quality blackgum, sweet gum, sycamore, cottonwood, and some of the big-leaf elms such as American and slippery elms.

Poles — Most utility and telephone poles are produced from pine, Douglas fir, cedar, and western larch timber. Pine species generally used are longleaf, lodgepole, shortleaf, loblolly, slash, and ponderosa pines. Poles and piling represent a high-value product for pine, cedar, fir, and larch. Occasionally some tall, straight hardwood species such as sweet gum may be used also for poles.

The specifications on pole timber are very high. Generally, only about five percent of the trees in a normal stand are suitable for poles. The most limiting factor is the form of the tree. If the tree has sweep or bend in one plane or direction, it cannot be more than one inch for each six feet of length. If the sweep is in two directions or places, it cannot fall outside the surface of the pole when a straight line is run, connecting the midpoint at the base of the pole and a midpoint at its top.

Poles must also be free of defects such as crossbreaks or cracks, bird holes, hollow butts or tops from red heart or other decay, or splits in the butt or top; they must also be free of metal. Each pole has to be free of scars or turpentine faces within two feet of the ground line. Limitations are placed also on the extent of spiral grain and on allowable knot sizes.

Pole lengths generally run from 25 - 75 feet in five-foot intervals.

Most poles are sold on a percentage of the delivered price. The stumpage price will generally average about 50 percent of the cut, peeled, and delivered price to the treating plant.

Piling — Piling is a specialty item generally pressure treated with creosote for use in the construction of bridges, docks, wharfs, foundations, and in other heavy general construction. The demand for piling is now limited, due to a shift to steel and concrete for much of the construction formerly done with wood piling.

The same requirements in selecting poles are employed in selecting piling, with the addition that piles must be shock resistant and generally straighter in form. Prices paid for piling are somewhat higher than those paid for poles.

Piling may be of any species of wood which will withstand driving and will support the required loads. Common piling species include southern pine, Douglas fir, elm, oak, maple, and cypress.

Veneer Timbers — Veneer timbers generally refer to large, high-quality hardwood species used to produce face veneers for paneling; commercial veneers for crossbands, cores, backs, and concealed furniture parts; and container veneers for baskets and boxes. In the broad sense, timber used to produce softwood plywood also falls into this category. Softwood plywood timber is generally purchased as sawtimber.

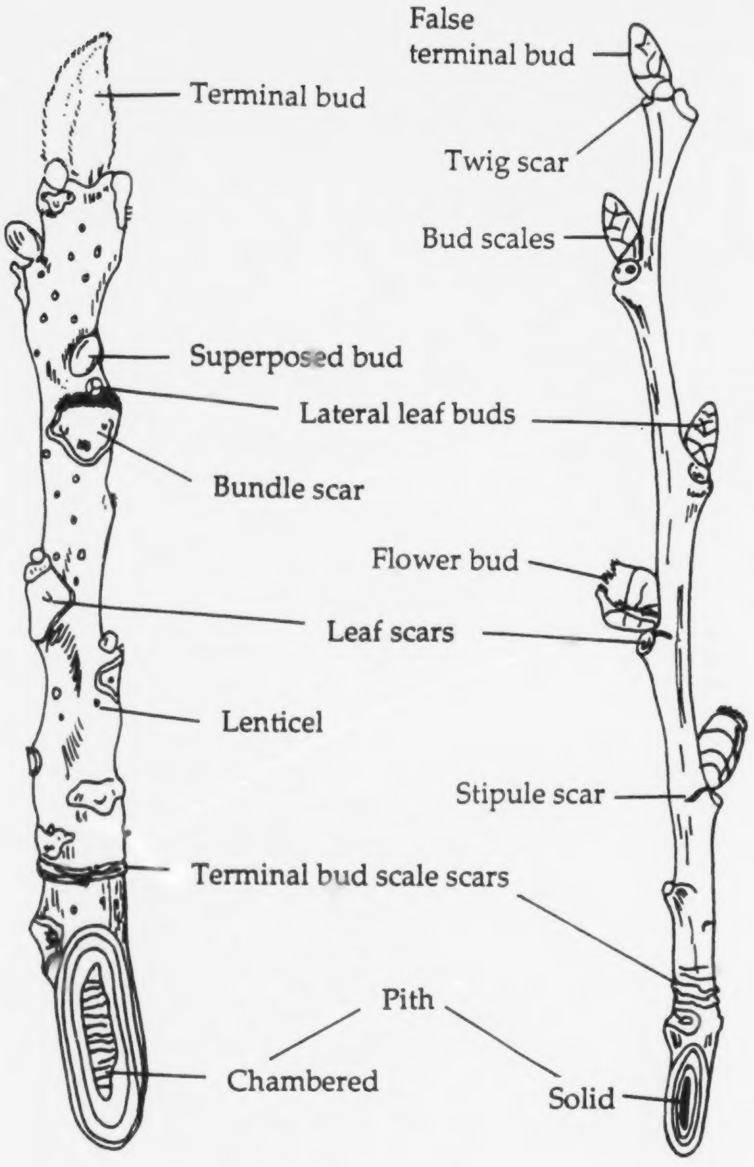
Virtually all species of hardwood timber of sufficient size and quality are used for veneer. This includes not only the gums, oaks, walnuts, ashes, and maples, but also such minor species as hickory, boxelder, persimmon, catalpa, and sassafras.

Veneer is a thin sheet of wood of uniform thickness produced by peeling, slicing, or sawing logs, bolts, and flitches. It may be cut thick enough to be used as is or glued together as thin sheets to form plywood. Thickness ranges from one-eighth to one inch of varied plies. Plywood is usually measured in terms of square feet of surface.

Wood is a renewable resource and is the most widely used construction material in the nation. Lumber, plywood, and pulp are the principal products derived from wood; however, many other products are derived from trees. Many more uses of trees for specific species can be found in the books, *Forest Trees of Illinois* and *Forests and Forestry*.

TRANSPARENCY MASTER #1

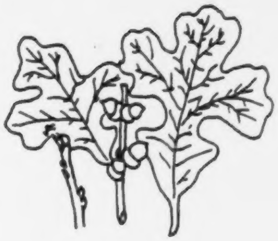
Features of Hardwood Twigs


False terminal bud
Terminal bud
Twig scar
Bud scales
Superposed bud
Lateral leaf buds
Bundle scar
Flower bud
Leaf scars
Lenticel
Stipule scar
Terminal bud scale scars
Pith
Chambered
Solid

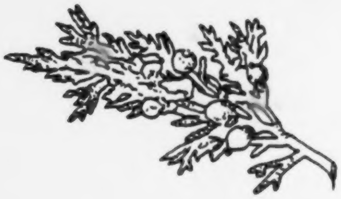
240

TRANSPARENCY MASTER #2

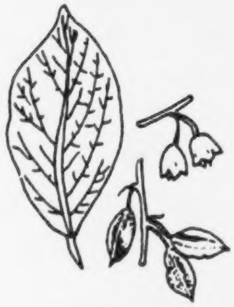
Leaves, Fruit, and Twigs of a Few Trees Which Compose the Central Hardwoods Forest Region



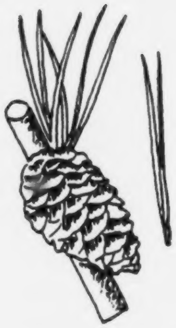
Post Oak



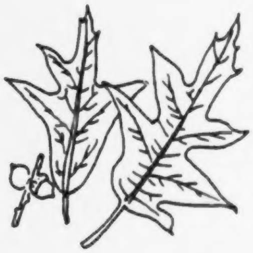
Eastern red cedar



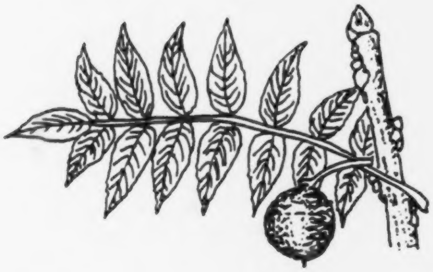
Silverbell



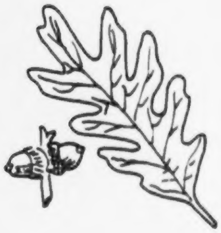
Shortleaf pine



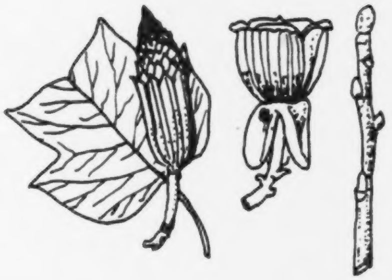
Southern red oak



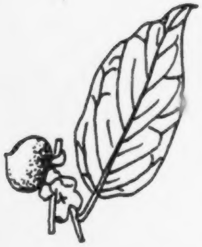
Black walnut



White oak



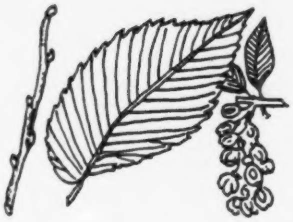
Yellow or tulip popular



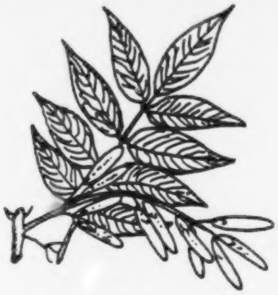
Persimmon

TRANSPARENCY MASTER #3

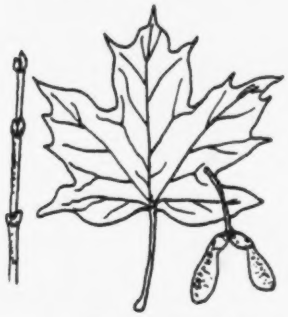
Leaves, Fruit, and Twigs of Hardwood Trees Characteristic of the Northern Forest Region



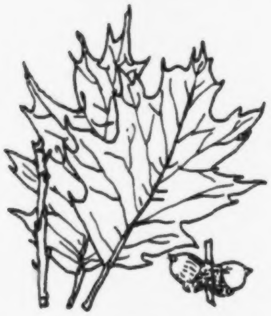
American elm



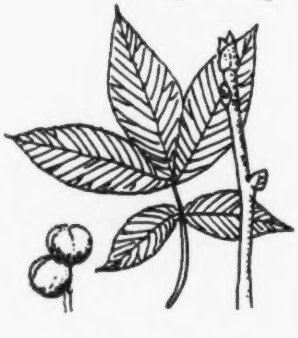
White ash



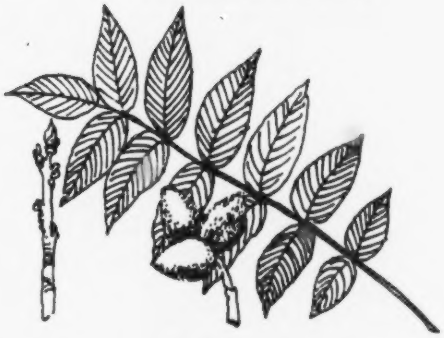
Sugar maple



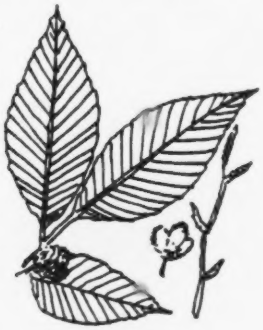
Northern red oak



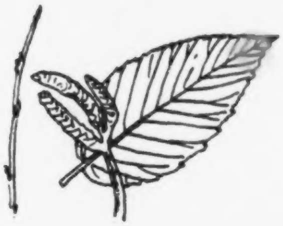
Pignut hickory



Butternut



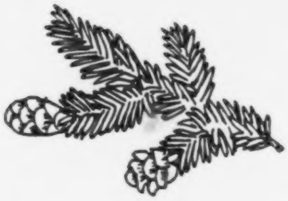
Beech



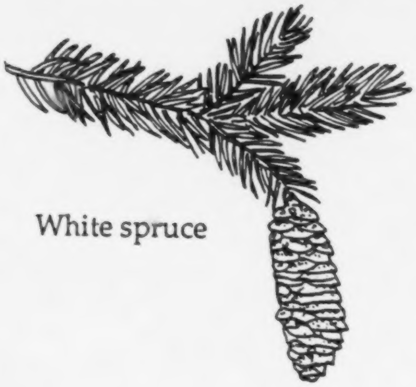
Sweet or black birch

TRANSPARENCY MASTER #4

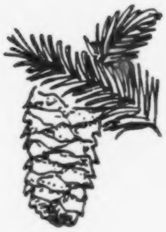
Cones and Leaves of Conifers Which Characterize the Northern Region



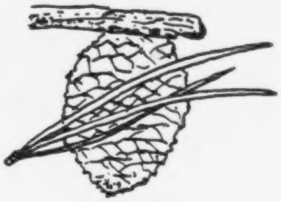
Eastern hemlock



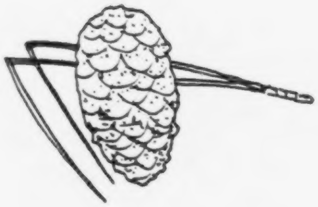
White spruce



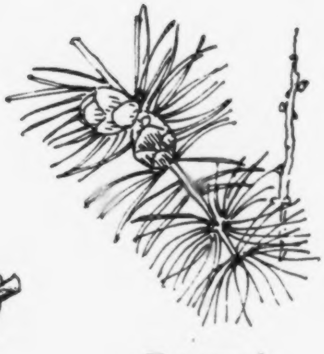
Red spruce



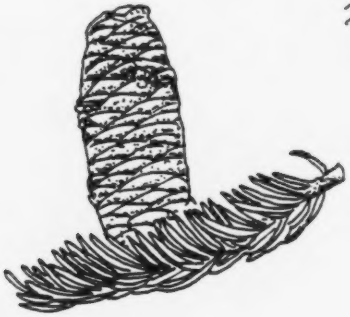
Pitch pine



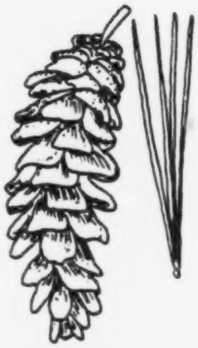
Red (Norway) pine



Tamarack



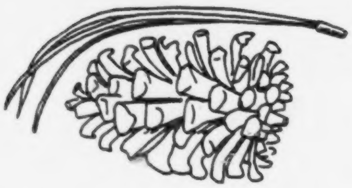
Balsam fir



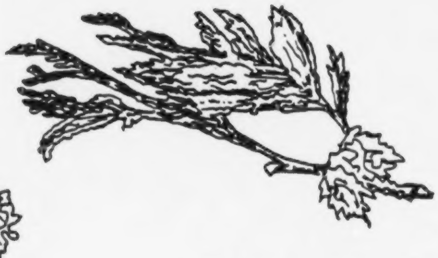
Northern white pine

TRANSPARENCY MASTER #5

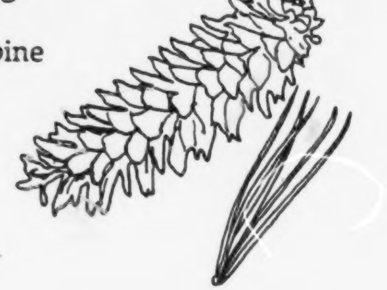
Cones and Leaves of Important Timber Trees of the Western Part of the United States



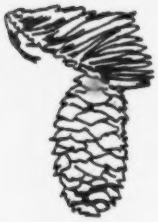
Ponderosa pine



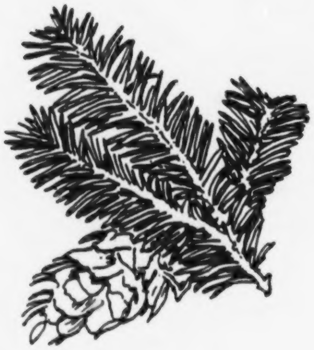
Western red cedar

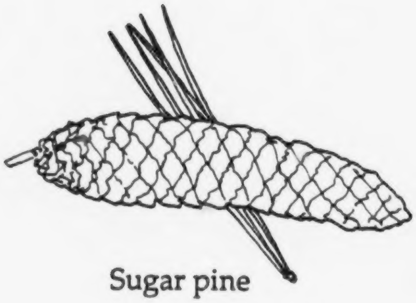


Western white pine

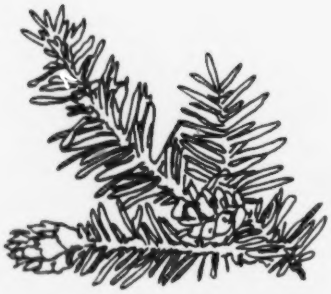


Englemann spruce

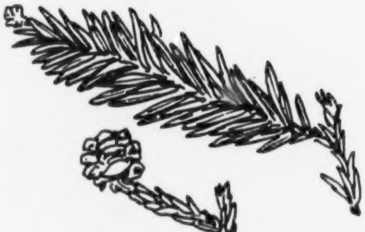




Sugar pine



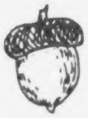
Douglas fir

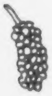


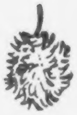
Coast redwood

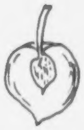
TRANSPARENCY MASTER #6

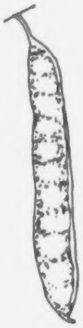
Common Types of Fruits and Seeds

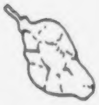

Acorn
(oak)

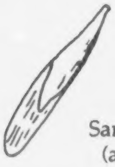

Multiple
fruit
(mulberry)

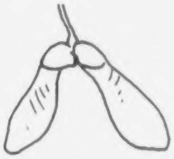

Nuts in
prickly bur
(beech)

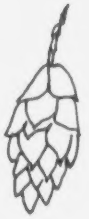

Drupe
(cherry)

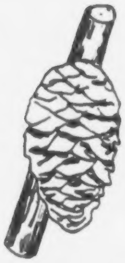

Pod
(locust)

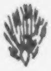

Samara
(elm)

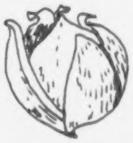

Samara
(ash)

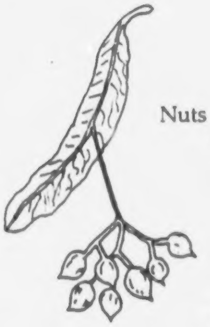

Samara
(maple)

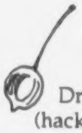

Nuts in bladder-like bracts
(hophornbeam)

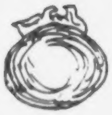

Cone
(pine)

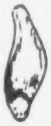

Hairy seed
(Willow)

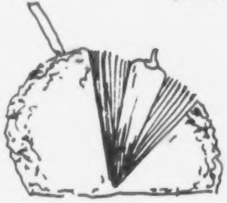

Nuts in husk
(hickory)

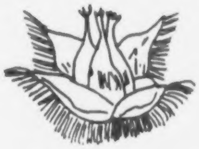

A nut-like drupe
(basswood)


Drupe
(hackberry)


Berry
(persimmon)

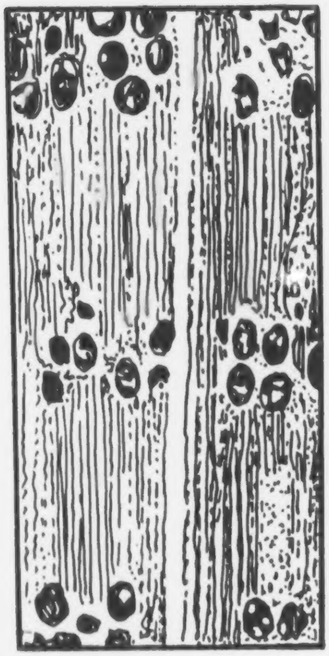

Winged seed
(pine)


Multiple-fruit
achene enlarged
(sycamore)

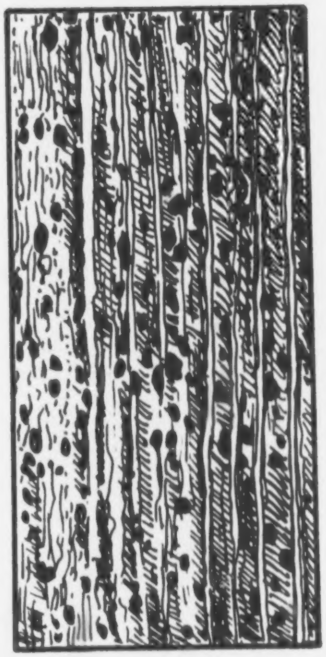

Nuts in spiny bur
(chinkapin)

TRANSPARENCY MASTER #7

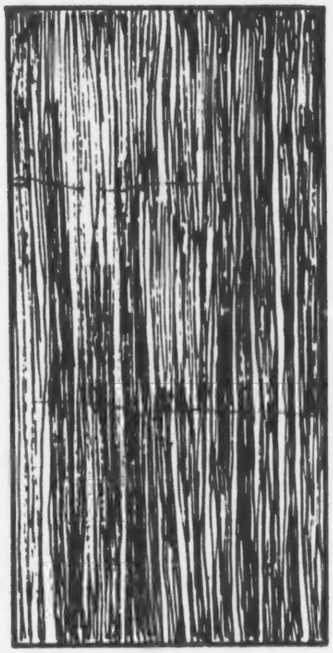
Porous and Non-Porous Wood



Ring-porous
White Oak



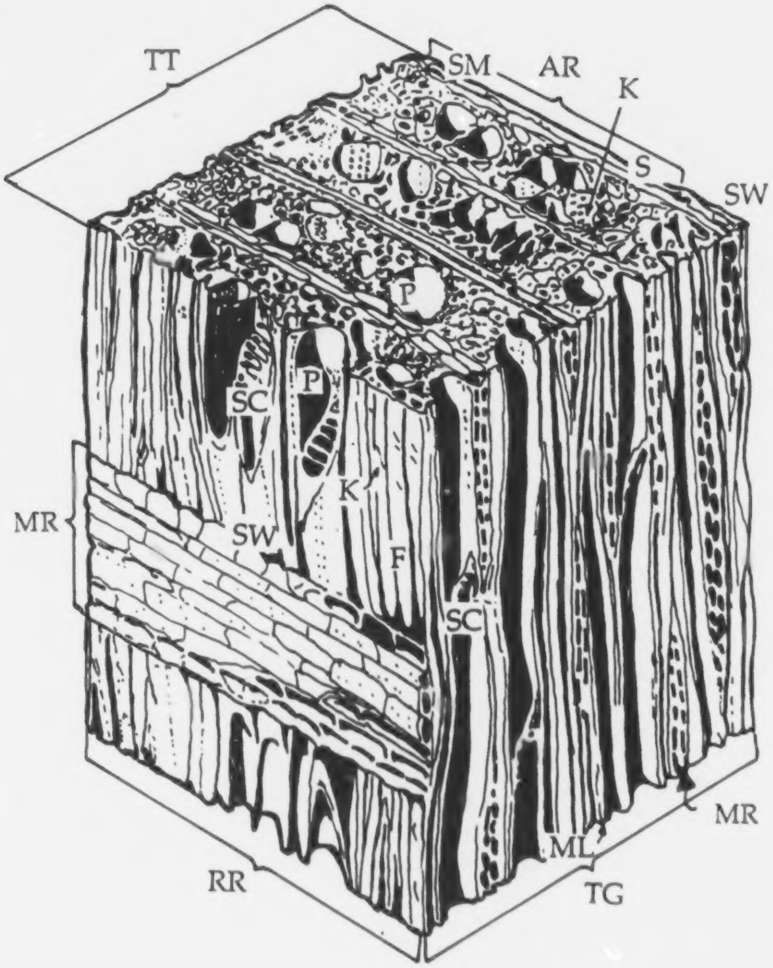
Diffuse-porous
Yellow birch



Non-porous
Engelmann spruce

TRANSPARENCY MASTER #8

Hardwood Structure



Hardwood — Oak

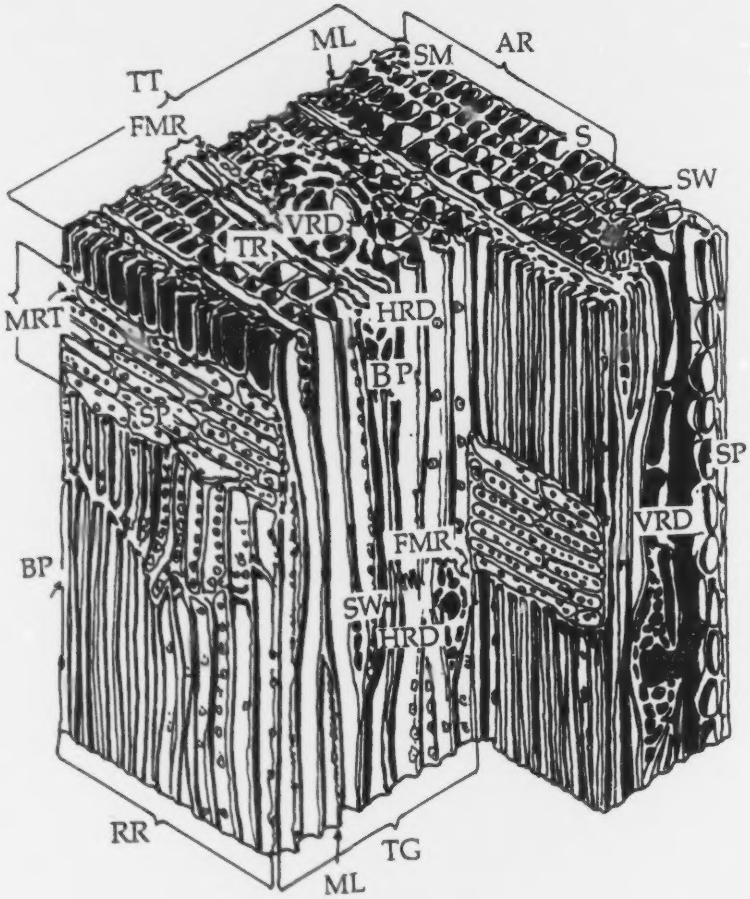
SM — SummerWood
AR — Annual Ring
K — Pits
S — Spring Wood
SW — Cell Wall
MR — Medullary Rays
ML — Middle Lamella

TG — Surface Cut at Right Angles to Radius
RR — Vertical Plane
SC — Cell Grating
F — Fiber
P — Pores
TT — Horizontal Plane

See *Forests and Forestry* for further detail.

TRANSPARENCY MASTER #9

Softwood Structure



Softwood — White Pine

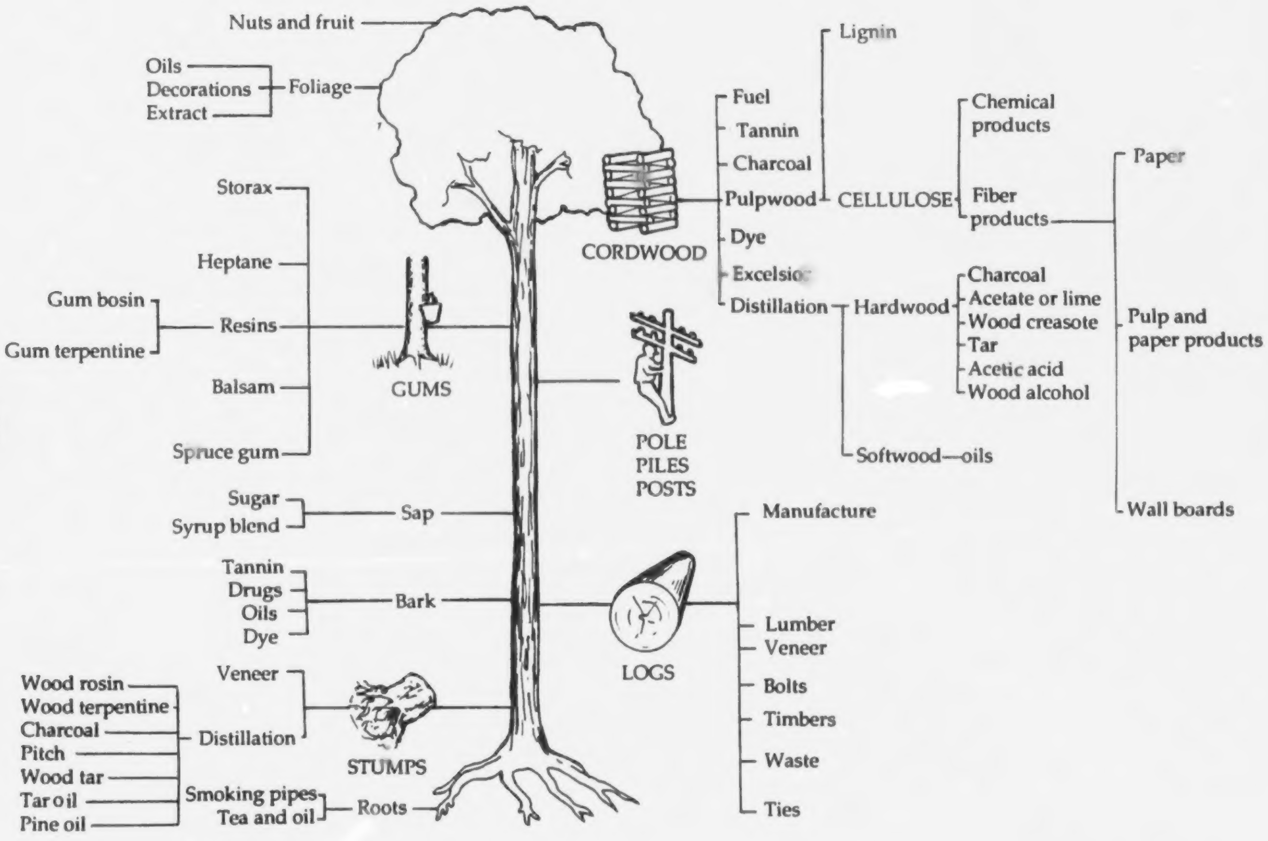
TT — Horizontal Plane
FMR — Fusiform Medullary Ray
TR — Tracheids
VRD — Vertical Resin Ducts
HRD — Horizontal Resin Duct
BP — Bordered Pits
ML — Middle Lamella
SM — Summer Wood
AR — Annual Ring

S — Spring Wood
SW — Cell Wall
MR — Medullary Rays
SP — Simple Pits
MRT — Medullary Ray Tracheid
RR — Edge Grain
TG — Surface Cut at Right Angles to Radius
MR — Medullary Rays

See *Forests and Forestry* for further detail.

TRANSPARENCY MASTER #10

Forest Products Derived from Commercial Tree Species


Nuts and fruit
Oils
Decorations
Extract
Foliage
Storax
Heptane
Gum bosin
Gum terpentine
Resins
Balsam
Spruce gum
GUMS
Sugar
Syrup blend
Sap
Tannin
Drugs
Oils
Dye
Bark
Wood rosin
Wood terpentine
Charcoal
Pitch
Wood tar
Tar oil
Pine oil
Veneer
Distillation
STUMPS
Smoking pipes
Tea and oil
Roots
CORDWOOD
Fuel
Tannin
Charcoal
Pulpwood
Dye
Excelsior
Distillation
Lignin
CELLULOSE
Chemical products
Fiber products
Paper
Pulp and paper products
Wall boards
Hardwood
Charcoal
Acetate or lime
Wood creasote
Tar
Acetic acid
Wood alcohol
Softwood—oils
POLE
PILES
POSTS
LOGS
Manufacture
Lumber
Veneer
Bolts
Timbers
Waste
Ties

STUDENT ACTIVITIES

STUDENT WORKSHEET #1 — Using Lumber in Construction

STUDENT WORKSHEET #2 — Using Plywood in Construction

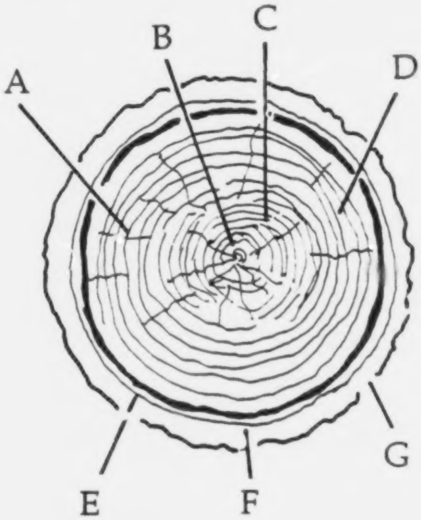
For additional activities, teachers may refer to the "Suggested Teaching Activities and Procedures" section in the Instructor's Guide.

STUDENT WORKSHEET #1

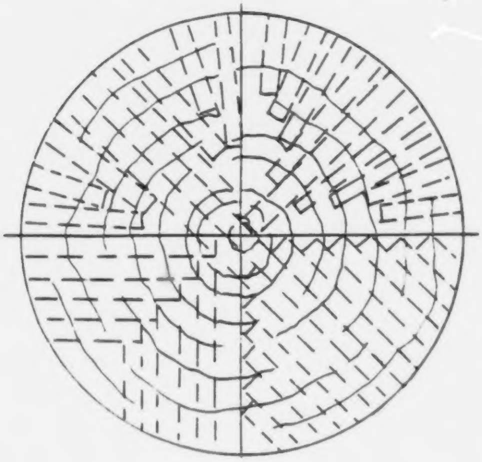
Using Lumber in Construction

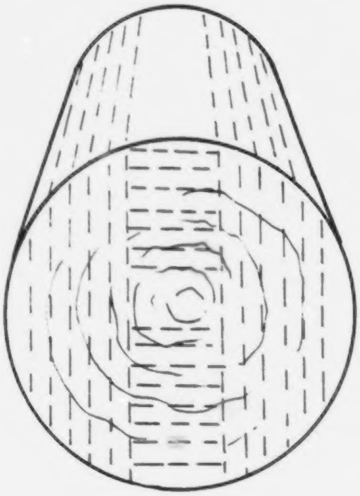
(Reference VAS Unit 3055)

1. Identify the following parts of the cross section of a tree trunk.



2. Identify the two common methods of cutting boards from logs.





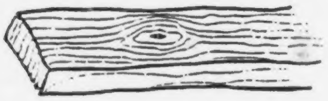
_______________ _______________

What are the advantages of each method?

3. Wood is classified according to the type of tree from which it is cut. Coniferous (cone-bearing) trees produce ______________ lumber and deciduous (broad-leaved) trees produce ______________ lumber.

4. Generally, carpenters use hardwood lumber for _________ , _________ , _________ , _________ and use softwood lumber for ___________________________.

5. Identify the following common defects or irregularities found in lumber.



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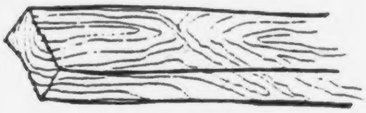

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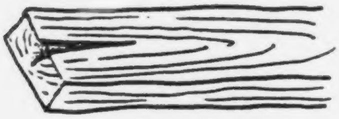

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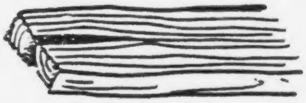

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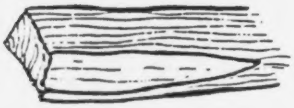

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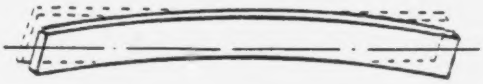


____

6. Define the term "board foot" and give the formula to determine board feet.

7. Using the Board Foot Table, determine the board feet in the following:

Sizes	Board Feet
a. 2"x10"x14' =	____________________
b. 4"x4"x8' =	____________________
c. 5 boards 1"x10"x12' =	____________________
d. 25 boards 2"x6"x8' =	____________________

8. How can lumber be kept in top quality before it is used?

9. Identify the common trees growing in your county.

Softwood	Hardwood

10. How can you determine the approximate age of trees?

11. What would happen to a tree if all the bark is cut from the trunk of a tree?

12. What type of lumber is sold by:
    - a. board foot:
    - b. square foot or sheet:
    - c. linear foot:

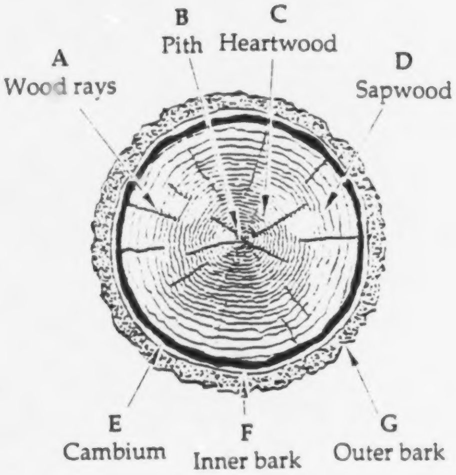
13. Identify some woodworking projects which could be done for your home or school.

STUDENT WORKSHEET #1 — Key

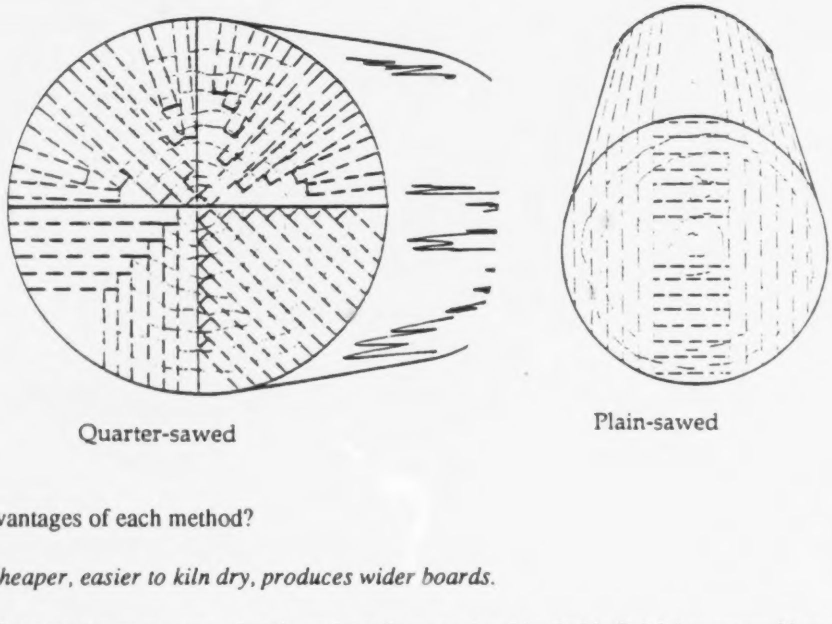
Using Lumber in Construction

(Reference VAS Unit 3055)

1. Identify the following parts of the cross section of a tree trunk.


A
Wood rays
B
Pith
C
Heartwood
D
Sapwood
E
Cambium
F
Inner bark
G
Outer bark

2. Identify the two common methods of cutting boards from logs.


Quarter-sawed
Plain-sawed

What are the advantages of each method?

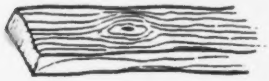
Plain-sawed: Cheaper, easier to kiln dry, produces wider boards.

Quarter-awed: Less tendency to warp, shrink, and swell; more durable; holds finish better; and has prettier grain.

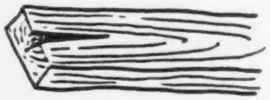
3. Wood is classified according to the type of tree from which it is cut. Coniferous (cone-bearing) trees produce *softwood* lumber and deciduous (broad-leaved) trees produce *hardwood* lumber.

4. Generally, carpenters use hardwood lumber for *furniture, cabinetry, flooring, etc.*, and use softwood lumber for *general building construction, subflooring, fencing, etc..*

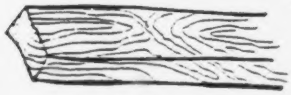
5. Identify the following common defects or irregularities found in lumber.



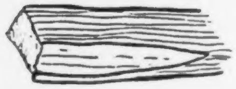
Knot



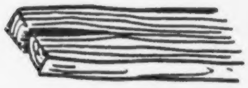
Check



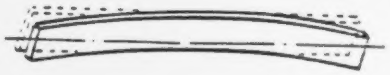
Cross grain



Wane



Shake



Bow

6. Define the term "board foot" and give the formula to determine board feet.

Board feet = $\frac{\text{number of boards} \times T'' \times W'' \times L'}{12}$

(If the length is in inches instead of feet divide by 144.)

7. Using the Board Foot Table, determine the board feet in the following:

Sizes	Board Feet
a. 2"x10"x14' =	*23 1/3*
b. 4"x4"x8' =	*24*
c. 5 boards 1"x10"x12' =	*50*
d. 25 boards 2"x6"x8' =	*200*

8. How can lumber be kept in top quality before it is used?

Do not order far in advance; keep it neatly stacked, using spacers for air circulation; keep level, off the ground, and covered.

9. Identify the common trees growing in your county.

Softwood	Hardwood

10. How can you determine the approximate age of trees?

    By counting the number of growth rings in the cross section of a freshly cut tree near ground level.

11. What would happen to a tree if all the bark is cut from the trunk of a tree?

    The tree would die because the cambium layer would be damaged and the xylem and phloem cell layers could not transport water and food.

12. What type of lumber is sold by:

    a. board foot: *Most construction lumber which has been worked or dressed.*

    b. square foot or sheet: *Plywood, particle board, and paneling, etc.*

    c. linear foot: *Moldings, trim, and some siding materials.*

13. Identify some woodworking projects which could be done for your home or school.

STUDENT WORKSHEET #2

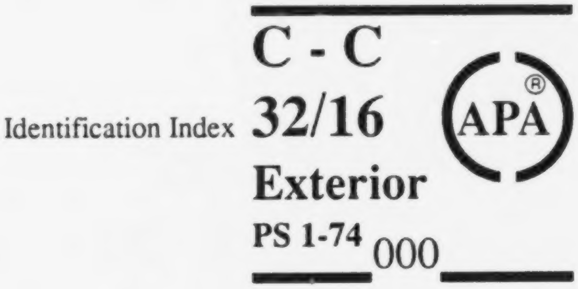
Using Plywood in Construction

(Reference VAS Unit 3042 and transparencies on Plywood Construction)

1. What are some of the major advantages of using plywood in agricultural construction?

2. What determines the "type of plywood?"

3. What does the following identification Index Number tell about the engineered grade of plywood?



4. What should be the minimum plywood thickness for single wall construction of a utility building with a 24-inch stud spacing where the panels will be placed horizontally for exterior use? (Refer to Table 7.)

STUDENT WORKSHEET #2 — Key

Using Plywood in Construction

1. What are some of the major advantages of using plywood in agricultural construction?

   a. *Structural strength*
   b. *Durability*
   c. *Low cost*
   d. *Little waste*
   e. *Good insulation*
   f. *Convenient and available*
   g. *Good finishing properties*
   h. *Resists expansion and contraction*

2. What determines the "type of plywood?"

   a. *The resistance to moisture*
   b. *The kind of glue used*
   c. *The veneer grades*
   d. *The manufacturing techniques*

3. What does the following identification Index Number tell about the engineered grade of plywood?

   The number on the left indicates the maximum recommended spacing for roof supports in inches.

   The number on the right indicates the maximum recommended spacing for subflooring supports.

   C - C
   Identification Index **32/16** **APA**®
   Exterior
   PS 1-74 000

4. What should be the minimum plywood thickness for single wall construction of a utility building with a 24-inch stud spacing where the panels will be placed horizontally for exterior use? (Refer to Table 7.)

   Use plywood which is no thinner than 3/8".

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Forestry

PROBLEM AREA: Managing Forestry Resources

RELATED PROBLEM AREAS:

1. Producing Christmas Trees
2. Processing Forest Products
3. Managing Land Resources
4. Conserving Water Resources
5. Maintaining Wildlife Habitat
6. Managing Parks and Recreational Areas
7. Understanding the Relationship Between Agriculture and the Environment (Central Core Cluster)

PREREQUISITE PROBLEM AREA(S):

1. Classifying Trees
2. Identifying Trees and Forestry Products

LEVEL: Preparatory

OCCUPATIONAL TASKS ADDRESSED:

Duty A: Managing the Recreational Facility

1. Complete weekly receipts
2. Complete invoices
3. Requisition materials, supplies, and services
4. Maintain inventory records
5. Maintain equipment maintenance records
6. Follow work schedule
7. Contribute to annual park management update
8. Identify specific recreational program needs for visitors
9. Complete business forms
10. Communicate orally with visitors
11. Assist in assessing and collecting fees and charges
12. Determine land-use capability
13. Assist in development of resource conservation plans
14. Interpret maps, charts, and aerial photographs

Duty B: Applying Laws, Regulations, and Policies

1. Interpret visitor disciplinary processes
2. Patrol park areas

3. Maintain permits, certificates and licenses
4. Greet and meet people
5. Maintain wildfire protection lanes

Duty C: Performing Promotional Activities

1. Conduct a visitors' program and tour
2. Register visitors
3. Give information and directions in a variety of formal and informal settings
4. Implement environmental education programs

Duty D: Managing Facility Flora and Fauna

1. Identify plant communities and dominant species within a selected area
2. Identify native plant species within a selected area

Duty H: Applying Safety Practices

1. Use fire extinguisher
2. Implement plans to protect animals and plants and other resources from visitors

STATE GOALS FOR LEARNING

In planning the instruction for this problem area, teachers can promote the development of several student learning objectives which are related to the State Goals for Learning in Biological and Physical Sciences and Social Sciences. These objectives are listed on the Learning Assessment Plan forms included on the following page(s). Those learning objectives marked with an asterisk (*) are taken from the sample lists provided by the Illinois State Board of Education.

Illinois Agricultural Core Curriculum
Agricultural Education 124 Mumford Hall 1301 W. Gregory Drive University of Illinois Urbana, IL 61801

Director: Dale A. Law, Ed.D.
Principal Investigator: Jerry D. Pepple, Ed.D
Research Assistant: Kevin J. Enderlin

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

Submission Date ____________
☐ Original submission ☐ Revision
Page ____ of ____

(Affix label or complete district information.)
COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐
District Name
City

I. LEARNING AREA *(check one)*
☐ Language Arts ☐ Fine Arts
☐ Mathematics ☒ Social Sciences
☐ Sciences ☐ Physical Development/Health

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will be able to apply the skills and knowledge gained in the social sciences to decision making in life situations.

Contact Person: ____________
Title: ____________
Phone: (   )

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Understand the knowledge and skills required for success in selected fields of work.					
*2. Recognize that competence in a field of work entails the development of a wide range of skills.					
3. Identify measurements used to identify the volume of wood in a tree or tree stand.					
4. Identify the non-professional and professional careers in forestry.					
5. Correctly identify the methods of tree planting.					
6. Identify the types of forest fires and methods used to fight them.					
7. Identify the classification of forest insects and the damage each inflicts.					

ISBE 41-78 (1/88)

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

Submission Date ____________________
☐ **Original submission** ☐ **Revision**
Page ____ of ____

I. LEARNING AREA *(check one)*

☐ Language Arts ☐ Fine Arts
☐ Mathematics ☒ Social Sciences
☐ Sciences ☐ Physical Development/Health

(Affix label or complete district information.)

COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐

District Name

City

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will be able to demonstrate a knowledge of world geography with emphasis on the United States.

Contact Person: ____________________
Title: ____________________
Phone: (   )

III. LEARNING OBJECTIVES	**IV. ASSESSMENT**				**V. EXPECTATIONS**
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Understand how decisions affecting the use of the natural environment can have both positive and negative results.					
*2. Understand how habitats have been modified by human activity.					
3. Discuss the importance of forests and forest products to our nation.					
4. Identify the methods by which timber is sold.					

Managing Forestry Resources

Illinois Agricultural Core Curriculum Rev.

Agricultural Resources
Forestry

ISBE 41-78 (1/88)

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

Submission Date ______________
☐ **Original submission** ☐ **Revision**
Page ____ of ____

I. LEARNING AREA *(check one)*
☐ Language Arts
☐ Mathematics
☒ Sciences
☐ Fine Arts
☐ Social Sciences
☐ Physical Development/Health

(Affix label or complete district information.)
COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐
District Name
City

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will have a working knowledge of the social and environmental implications and limitations of technological development.

Contact Person: ______________
Title: ______________
Phone: (   )

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Understand potential consequences resulting from interaction between technological advances and the environment.					
*2. Understand ways that people can minimize the depletion of earth's resources.					
3. Identify the beneficial influences of trees.					
4. Correctly identify the types of silvicultural practices used in forestry management.					
5. Identify the methods used in the process of reforestation.					

ISBE 41-78 (1/88)

Submission Date ____________
☐ Original submission ☐ Revision
Page ____ of ____

I. LEARNING AREA *(check one)*
☐ Language Arts
☐ Mathematics
☒ Sciences
☐ Fine Arts
☐ Social Sciences
☐ Physical Development/Health

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

(Affix label or complete district information.)

COUNTY	DISTRICT	ESC

District Name

City

Contact Person: ____________
Title: ____________
Phone: (   )

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will have a working knowledge of the concepts and basic vocabulary of biological, physical and environmental sciences and their application to life and work in contemporary technological society.

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Identify the components necessary for a community to exist and survive.					
*2. Know the principal environmental factors that limit the distribution of plants and animals.					
*3. Understand that an ecosystem consists of a community interacting with its physical environment.					
4. Identify the beneficial influences of trees.					
5. Identify the physical and biological factors that affect the forest environment.					
6. Identify the types of forest fires and methods used to fight them.					
7. Identify the classification of forest insects and the damage each inflicts.					

ISBE 41-78 (1/88)

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Forestry

PROBLEM AREA: Managing Forestry Resources

STUDENT LEARNING OBJECTIVES

Upon completion of their study of this problem area, students will be able to:

1. Discuss the importance of forests and forest products to our nation.
2. Identify the 15 beneficial influences of trees.
3. Identify measurements used to determine the volume of wood in a tree or tree stand.
4. Correctly measure a tree's dbh and usable height using a Biltmore stick.
5. Correctly estimate wood volume in a tree stand by doing a total or partial timber cruise.
6. Identify the physical and biological factors that affect the forest environment.
7. Identify the non-professional and professional careers in forestry.
8. Correctly discuss the stages of tree development.
9. Correctly identify the types of silvicultural practices used in forestry management.
10. Identify the methods used in the process of reforestation.
11. Correctly identify the methods of tree planting.
12. Successfully heel in a bale of tree seedlings.
13. Correctly plant a tree seedling using the planting bar.
14. Identify the methods by which timber is sold.
15. Develop a written document for use in a timbersale.
16. Identify the types of forest fires and methods used to fight them.
17. Identify the classification of forest insects and the damage each inflicts.

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Forestry

PROBLEM AREA: Managing Forestry Resources

PROBLEMS AND QUESTIONS FOR STUDY	INSTRUCTOR'S NOTES AND REFERENCES
1. Why are forests important to our nation?	
2. What are the beneficial influences of trees?	
3. What are the ways in which volumes of wood can be measured?	
4. How is the amount of usable lumber estimated in a standing tree?	
5. What is meant by timber cruising and how is it done?	
6. What are the factors that make up a forest environment?	
7. What types of careers are available in forestry and forest products?	
8. What are the stages of tree development?	
9. What are silvicultural practices?	
10. What is meant by reforestation?	
11. How can tree seedlings be planted?	
12. How does an owner sell the timber in a private forest?	
13. What are the types of forest fires and what methods are used to fight them?	
14. What types of insects affect forest production?	

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Forestry

PROBLEM AREA: Managing Forestry Resources

SUGGESTED TEACHING ACTIVITIES AND PROCEDURES

1. Visit a tree nursery in your area.
2. Visit a local forest. Perform a timber cruise. Measure trees for dbh and usable height.
3. Visit a logging company in your area.
4. Order trees from the state conservation department and plant them in your local community.
5. Visit a lumber yard in your area and identify how lumber is measured and sold.
6. Visit a local forest and identify what management practices could be utilized to improve the stand.
7. Use "Farm Your Forest" Cooperative Extension Service circular #1291 as a resource for an example of a timber sale contract to be used as a student resource.

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Forestry

PROBLEM AREA: Managing Forestry Resources

REFERENCES

*1. *Forests and Forestry.* Holand, Rolfe, Anderson. Interstate Publishers, Inc., P.O. Box 50, Danville, IL 61834-0050. (217)446-0500.

*2. *Agricultural Resources - Fish, Wildlife, Recreation, Forest Resource Management.* Instructional Materials Service, F.E. Box 2588, Texas A & M University, College Station, TX 77843-2588.

3. Various Materials. Instructional Materials Laboratory, 10 Industrial Education Building, University of Missouri-Columbia, Columbia, MO.

*Indicates highly recommended reference

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTIONAL RESOURCES

These resources are intended for use by teachers in planning and teaching the materials for this problem area and may be adapted to fit the teaching method(s) used.

INFORMATION SHEET #1 — Importance of Forests to the Nation

INFORMATION SHEET #2 — Timberland Area in the United States by Ownership, Region, and State, 1987

INFORMATION SHEET #3 — Beneficial Influences of Trees

INFORMATION SHEET #4 — Status of Tree Farms Program as of October 1, 1988

INFORMATION SHEET #5 — Tree Measurement Units

INFORMATION SHEET #6 — Measuring Tree Diameter

INFORMATION SHEET #7 — Measuring Usable Height (Merchantable)

INFORMATION SHEET #8 — Log Measurements

INFORMATION SHEET #9 — Timber Cruising

INFORMATION SHEET #10 — The Forest Environment

INFORMATION SHEET #11 — Careers in Forestry Management

INFORMATION SHEET #12 — Tree Development Stages

INFORMATION SHEET #13 — Silvicultural Practices

INFORMATION SHEET #14 — Methods of Reforestation

INFORMATION SHEET #15 — Tree Planting

INFORMATION SHEET #16 — Marketing Timber

INFORMATION SHEET #17 — Forest Fire Control

INFORMATION SHEET #18 — Forest Insects

TRANSPARENCY MASTER #1 — Multiple Use of Forestlands

TRANSPARENCY MASTER #2 — Measurement Units

TRANSPARENCY MASTER #3 — Measuring Diameter

TRANSPARENCY MASTER #4 — Board Foot Volume of Trees by Diameter and Height Classes

TRANSPARENCY MASTER #5 — Measuring Tree Height

TRANSPARENCY MASTER #6 — International ¼" Log Rule Table

TRANSPARENCY MASTER #7 — Cord Volume Table

TRANSPARENCY MASTER #8 — Timber Cruising

TRANSPARENCY MASTER #9 — Non-Professional Careers in Forestry

TRANSPARENCY MASTER #10 — Principal Harvest Cutting Methods

TRANSPARENCY MASTER #11 — Improvement Cutting

TRANSPARENCY MASTER #12 — Techniques for Thinning

TRANSPARENCY MASTER #13 — Natural Seeding

TRANSPARENCY MASTER #14 — Methods of Direct Seeding

TRANSPARENCY MASTER #15 — Mechanical Tree Planting

TRANSPARENCY MASTER #16 — Use of Planting Bar in Hand Planting

TRANSPARENCY MASTER #17 — Recommended Method for Care and Storage of Seedlings

TRANSPARENCY MASTER #18 — Uses of Trees

TRANSPARENCY MASTER #19 — Planting Forest Trees

TRANSPARENCY MASTER #20 — "Mopping Up" After a Fire

TRANSPARENCY MASTER #21 — Indirect Fire Fighting

TRANSPARENCY MASTER #22 — Direct Fire Fighting

TRANSPARENCY MASTER #23 — Safe Bucking Procedures

TRANSPARENCY MASTER #24 — Chain Saw Safety

TRANSPARENCY MASTER #25 — Using the Cant Hook

TRANSPARENCY MASTER #26 — Types of Forest Insects Based on Tree Damage

INFORMATION SHEET #1

Importance of Forests to the Nation

481 million acres of timberland in the United States are being called upon to meet a rapidly increasing demand for wood.

To meet the country's needs and to process the raw materials are:

12,000 logging camps
7,500 sawmills
215 plywood plants
315 pulp mills

Lumbering operations, and plywood, pulp, paper, and furniture production employ more than 1.6 million persons with total earnings over $24 billion a year.

There has been an increasing use of forests as recreation areas, wilderness areas, and wildlife habitats. Forests are also increasingly utilized in improving the quality and quantity of water.

The U.S. imports 4.4 billion cubic feet of wood each year. This is equal to 25 percent of the total U.S. production.

Timberlands of the U.S. are currently producing only about one-half of their biological potential.

History of Pulpwood Demand in U.S.

1939 - 4.6 million cords
1966 - 33.1 million cords
1985 - 72 million cords

Approximate percentage of timber used for forestry products:

Lumber	46%
Pulpwood	42%
Veneer and plywood	9%
Poles, Posts, and Pilings	3%

INFORMATION SHEET #2

Timberland Area in the United States by Ownership, Region, and State, 1987

(thousand acres)

Region & State	Total Land Area	Forest Land Area	Federal	Indian	State	County & Municipal	Private
Northeast							
Connecticut	3,112	1,777	16	0	156	74	1,530
Delaware	1,268	388	0	0	14	0	374
Maine	19,789	17,175	76	118	331	88	16,561
Maryland	6,330	2,461	22	0	236	22	2,182
Massachusetts	5,009	3,010	40	0	292	142	2,536
New Hampshire	5,777	4,189	426	0	96	104	3,563
New Jersey	4,813	1,914	246	0	224	63	1,380
New York	30,612	15,799	123	0	899	193	14,583
Pennsylvania	28,778	16,186	552	0	2,879	113	12,642
Rhode Island	671	368	3	4	68	7	286
Vermont	5,931	3,609	140	0	219	65	3,186
West Virginia	15,405	11,799	1,070	0	250	0	10,479
North Central							
Illinois	35,679	4,030	292	0	55	42	3,641
Indiana	23,102	4,296	329	0	177	29	3,761
Iowa	35,802	1,459	43	0	52	7	1,357
Michigan	36,364	17,342	2,498	22	3,581	187	11,053
Minnesota	50,745	13,571	1,825	465	2,654	2,334	6,293
Missouri	44,157	11,996	1,390	0	242	25	10,339
Ohio	26,224	7,229	171	0	173	79	6,806
Wisconsin	34,857	14,727	1,419	355	569	2,179	10,204
Great Plains							
Kansas	52,344	1,207	37	4	7	2	1,157
Nebraska	48,949	536	29	9	22	4	473
North Dakota	44,335	337	12	31	22	2	271
South Dakota	41,732	1,443	912	39	86	3	403
Southeast							
Florida	34,618	15,238	1,577	6	542	41	13,072
Georgia	37,167	23,383	1,421	0	118	70	21,775
North Carolina	31,231	18,359	1,365	53	332	80	16,529
South Carolina	19,344	12,179	913	1	233	27	11,005
Virginia	25,459	15,436	1,707	0	209	77	13,442
South Central							
Alabama	32,453	21,659	950	0	147	63	20,498
Arkansas	33,245	16,673	2,659	0	311	41	13,662
Kentucky	25,376	11,908	856	0	34	0	11,019
Louisiana	28,755	13,873	833	0	330	168	12,542
Mississippi	30,269	16,673	1,488	5	100	132	14,949
Oklahoma	44,021	4,748	464	46	115	7	4,116
Tennessee	26,449	12,839	958	0	373	29	11,480
Texas	167,766	11,566	694	6	56	12	10,797

Region & State	Total Land Area	Forest Land Area	Federal	Indian	State	County & Municipal	Private
			(thousand acres)				
Pacific Northwest							
Alaska	362,516	15,763	4,936	22	4,622	20	6,163
Oregon	61,558	21,749	12,126	315	827	102	8,379
Washington	42,605	16,848	5,025	1,376	2,025	225	8,197
Pacific Southwest							
California	100,071	16,712	9,051	99	95	12	7,455
Hawaii	4,112	700	0	0	336	2	362
Rocky Mountains							
Arizona	72,587	3,789	2,515	1,219	12	0	43
Colorado	66,410	11,740	8,144	50	274	46	3,226
Idaho	52,913	14,534	10,310	38	1,036	51	3,099
Montana	93,175	14,737	8,742	622	638	2	4,733
Nevada	70,329	221	106	0	3	0	112
New Mexico	77,704	5,180	2,893	581	112	0	1,594
Utah	52,541	3,078	2,314	30	150	17	567
Wyoming	69,210	4,332	2,685	112	203	0	1,332

(Source: U.S. Forest Service, Preliminary RPA Review Draft, 1988)

INFORMATION SHEET #3

Beneficial Influences of Trees

In addition to the direct value of products derived from trees, trees provide many indirect benefits which are often overlooked.

1. Influence on climate — Forests are cooler in the summer and warmer in the winter than are open areas. Air within a forest is more moist than in open areas.
2. Control of runoff — During a rainstorm the impact of raindrops is broken by leaves and branches. Forest floor ground litter absorbs the water, reducing surface runoff.
3. Retention of snowmelt — By delaying the melting of snow in the spring and by absorbing snow water into the forest floor, forests prolong the period of runoff. This also reduces flooding.
4. Environment for fish — Forest vegetation shades water areas from direct light of the sun. This assists in preventing excessive stream temperatures.
5. Flood prevention and water flow — Forested watersheds reduce extreme waterflow in winter and summer. This helps to prevent loss of topsoil, flash floods, and sediment buildup in streams and rivers.
6. Wildlife habitat — Forests provide food and shelter for many kinds of wildlife. When trees and other forest vegetation are destroyed, all wildlife may disappear for a long time.
7. Prevention of soil erosion — Water that moves through forested soils does so more slowly and stays free of sediment.
8. Reduction of wind erosion — Trees reduce the speed of wind. This cuts down on the amount of soil lost each year as a result of wind erosion.
9. Habitat for songbirds — Songbirds are not found in dense forests. They prefer a combination habitat with forest trees and open areas.
10. Removal of gas pollutants — Trees remove pollutants from the air, water, and soil.
11. Removal of particles from the air — Tree leaves filter out particles from the air. The particles are gathered and held to the leaves by small hairs present on the leaves.
12. Noise abatement — Trees can be effective in reducing noise if placed between the noise source and people.
13. Increase in water-holding capacity of soils — A single full-grown oak tree can transpire 50 gallons of water on a hot day. Trees pump water from the soil allowing storage of additional runoff.
14. Effect on property values — Property values are enhanced if trees are growing on a city lot or building site.

INFORMATION SHEET #4

Status of Tree Farms Program
as of October 1, 1988

State	Number of Tree Farms	Acreage
Alabama	2,525	7,274,503
Alaska	24	1,253
Arizona	27	3,930
Arkansas	3,984	4,508,906
California	670	3,745,682
Colorado	199	72,147
Connecticut	516	137,248
Delaware	130	36,514
Florida	3,146	6,875,197
Georgia	3,874	7,497,184
Hawaii	2	814
Idaho	721	1,619,190
Illinois	805	73,166
Indiana	995	116,809
Iowa	499	38,753
Kansas	322	12,301
Kentucky	809	286,639
Louisiana	2,988	5,535,103
Maine	1,813	7,303,769
Maryland	1,130	241,092
Massachusetts	1,330	242,609
Michigan	1,958	2,202,649
Minnesota	2,162	901,331
Mississippi	5,366	3,686,533
Missouri	790	585,618
Montana	420	1,994,454
Nebraska	192	9,092
Nevada	3	13,064
New Hampshire	1,260	786,695
New Jersey	211	78,967
New Mexico	74	108,458
New York	1,483	972,950
North Carolina	3,008	2,544,691
North Dakota	277	14,080
Ohio	1,708	409,824
Oklahoma	296	1,244,291
Oregon	985	6,247,013
Pennsylvania	1,661	856,800
Rhode Island	175	36,185
South Carolina	1,528	3,323,502
South Dakota	218	47,662
Tennessee	1,523	2,216,476
Texas	3,119	4,203,991
Utah	5	11,048
Vermont	871	538,555
Virginia	2,215	2,055,877
Washington	716	5,140,149
West Virginia	588	1,393,464
Wisconsin	2,414	1,860,802
Wyoming	10	13,565
Totals	**61,745**	**89,120,595**

(Source: American Forest Council)

INFORMATION SHEET #5

Tree Measurement Units

Tree measurement is important for:

1. Determining the volume of wood in a tree.
2. Determining the volume of wood in a timberstand.

Units of volume used to describe wood products

1. Board foot — A piece of rough wood one foot square and one inch thick, usually sold on a basis of MBF (thousand board feet).
2. Cubic foot — A cube of wood one foot on each side.
3. Cord — A stack of wood which measures four feet by four feet by eight feet. A cord of wood is equal to 128 cubic feet.

   Number of cords = [length x width x height (in feet)] ÷ 128
4. C unit — A stack of wood containing 100 square feet of solid wood with no air spaces between boards.
5. Piece — A unit of measurement which refers to the number or quantity of timber products of a specified dimension.
6. Linear feet — Some forest products are sold in terms of linear feet. Length may be in 1-, 2-, 5- or 10-foot categories.
7. Basal Area — Unit of measurement for standing timber.

INFORMATION SHEET #6

Measuring Tree Diameter

Because the bases of most trees have a swell, diameter measurements of standing trees are made at breast height, which is 4 ½ feet above ground.

There are two main instruments used to measure tree diameter. They are the diameter tape and the cruising stick. The diameter tape shows tree diameter by measuring the circumference of the tree. It is based on the fact that circumference of a circle is equal to the circle's diameter multiplied by 3.14. Each division on the diameter tape is 3.14 inches apart with each division representing one inch of the tree's diameter.

The cruising stick does not generally give as accurate a measurement as the diameter tape, but is much faster. To use the cruising stick, hold it horizontally at arms length (25 inches from your eye) against the tree. Be sure you are holding the stick 4 ½ feet above the ground.

The front side of the stick (the side with units of measurement) should be facing you. Line up the zero end with the outside of the tree. Then without moving your head, and using only one eye, look at the other side of the tree and read the figure nearest to where your line of sight crossed the stick and the edge of the tree. Tree diameters are most commonly recorded in two inch classes.

INFORMATION SHEET #7

Measuring Usable Height (Merchantable)

Tree height is usually measured from a stump height of six inches, to a point on the stem beyond which salable saw logs or other products cannot be cut.

1. Saw logs (16 foot long) — The merchantable height is usually measured to a top diameter of not less than eight inches.
2. Cord wood (short logs called bolts) — Cord wood may be figured to a merchantable height of about a four inch diameter.

The usable height may be lowered if the top of the tree contains forking, large branches, or deformity.

To measure height, use the portion of the front of the stick marked off as 16 foot logs.

1. Begin with your heel at the base of the tree. Walk away from the tree a distance of 50 feet. Walk toward an opening which will allow you to see the tree you are measuring. Try to stay at the same elevation as the tree you are measuring when taking readings from your stick.
2. Decide where the last cut will be made when the tree is cut into logs.
3. Hold the stick at arms length (25 inches) from your eye in a vertical position. Be sure the side of the stick with the number of 16 foot logs is toward you.
4. Position the stick so that the lower end is even with your line of sight to the stump height of the tree.
5. Shift your vision upward on the tree without moving your head. Make sure the stick is not tilted forward or backward. Make your reading to the nearest half-log.

INFORMATION SHEET #8

Log Measurements

1. Saw logs — Generally measured by board feet. Logs are used for lumber, plywood, flooring, veneer, boxes, pallets, etc. *Diameter* of a log is measured at the small end inside the bark. *Length* of the log is measured to even two-foot lengths.
2. Pulpwood — The raw material from which paper, container board, and other paper products are made. Pulpwood can be measured on the basis of cubic feet, cords, C units, and weight.
3. Poles and piling — Forestry products that are sold on the basis of linear feet or the length in feet.
4. Railroad ties, posts, small poles — Usually sold by the piece or number.

INFORMATION SHEET #9

Timber Cruising

Timber cruising - The estimation of the volume of standing timber.

Types of timber cruising

The extent or percent of the cruise is based upon the timber values and the size of the stand. Generally, higher-valued timber justifies a higher percent of cruise.

1. Total cruise — This method involves measuring all trees in the timberstand. The volume for each tree is added to obtain an estimate of volume for the entire stand. It is the most accurate method of cruising but a costly one.
2. Partial cruise — If the woodland is large or time is short, a partial cruise may be made. This involves
   - a. Measuring a fraction of the trees in the stand.
   - b. Assuming that the remaining trees are similar to those measured.

The Cruise Report

Data gathered by measurements should be developed into a written report. Reports can be used to:

1. Develop overall plans for managing the timber tract.
2. Make a sale of timber.
3. Plan the logging of the stand.
4. Establish values for tax purposes.
5. Maintain general records on the property.

A map of appropriate scale may be made showing:

1. Physiographic features (drainages and ridges).
2. Property boundaries.
3. Improvements (roads, bridges, fences).
4. Locations of various types of species of trees.

Recommended Percent Cruise by Size of Timber Stand in Acres

Size of timber stand in acres	0 - 10	11 - 25	26 - 50	51 - 100	101+
Percent cruise	100	50	25	20	10 - 5

INFORMATION SHEET #10

The Forest Environment

The total tree environment is a very complex interaction between a number of physical and biological factors. A tiny pine seed should grow into a tall, majestic tree; however, in an unfavorable environment the seed may not even germinate.

Physical Factors Affecting Tree Growth

1. Temperature — Temperature directly affects plant growth. Photosynthesis speeds up as temperatures increase. The temperature range in which trees grow best varies from tree species to tree species.
2. Light — Radiant energy from the sun is important in triggering the photochemical reaction in chlorophyll. Sunlight is also important in regulating tree development including growth, leaf fall, flowering, fruiting, reproduction, and dormancy.
3. Air — Air is the source of carbon dioxide required for photosynthesis. Oxygen is also taken from the air for respiration.
4. Moisture — Moisture is the most limiting physical environmental factor affecting the growth of trees. Forests in the United States receive a wide range of annual precipitation. Annual precipitation can range from a high of about 140 inches to a low of about 15 inches. When soil moisture is low the tree automatically closes small leaf openings called stomata to reduce water lost through transpiration.
5. Soil — Soil directly affects the tree by anchoring it and serving as a growth medium. Soil also serves as a reservoir for moisture. Soil provides all the essential elements for tree growth except oxygen and carbon. Soil characteristics such as organic matter, texture, structure, chemical composition, and depth influence tree growth by affecting the supply of moisture and nutrients available to it.

Biological Factors Affecting Tree Growth

1. Reproduction — Reproduction is a vital process of every self-perpetuating tree. Reproductive habits vary widely from tree to tree. Seed formation depends on the amount of reserved carbohydrates and nitrogen in the tree. Pests can attack tree fruit, destroying the seed crop. Some trees can also reproduce by sprouting from the stump or roots.
2. Tree form — Trees in timbers usually direct a maximum of growth into the development of one main stem. Variations in tree form occur when certain trees are overtopped by others in the forest stand.
3. Tree tolerance — Tree tolerance refers to the tree's ability to withstand competition, such as occurs when developing in the shade of other trees.
4. Root growth — Root growth varies considerably from species to species. Root systems are adaptive and tend to modify themselves to suit the environmental conditions in which they grow.
5. Tree hardiness — Hardiness refers to the tree's ability to resist heat, cold, drought, insect infestations, disease attacks, and other elements limiting survival and growth.

INFORMATION SHEET #11

Careers in Forestry Management

Forestry product industries are major contributors to the national economy, ranking fourth in number of full-time employees, salaries, and in the value added by manufacture.

Forestry product industries offer a wide range of career opportunities for young men and women. Forestry product careers can be classified as either non-professional or professional.

Non-Professional Careers in Forestry

Logger
Logging operator
Lumber checker
Lumber grader
Machinery operator
Nurseryman
Pole inspector
Pulpwood dealer
Sales and service manager
Sawmill manager
Timber buyer
Timber cruiser
Timber cutter
Timber marker
Timber producer
Truck driver

Professional Careers in Forestry

Timber and wood procurement agent — A person who purchases timber and wood for industry use or for logging companies.

Forest ranger — Administrative officer in charge of forest land who advises timber growers and harvesters on forestry problems and conducts educational programs on care of forests.

Forest engineer — A person who performs engineering duties concerned with the growing and harvesting of trees.

Forest recreation manager — Manager of recreational areas who directs construction of cabins, roads, and fences within a recreational site.

Educator — A person who develops educational programs related to forestry for use in schools, civic organizations, and the news media.

Forest ecologist — A person who conducts research related to environmental factors that affect forests and forest products.

Wood technologist — A person who conducts research in seasoning, preserving, and utilizing wood and wood products.

INFORMATION SHEET #12

Tree Development Stages

Even-aged stands — Age difference of less than 15 years among trees in the stand.

Uneven-aged stands — Stands with greater variation among individual trees. Trees may vary from 1 - 100 years or more in age.

In uneven-aged stands, there are few recognizable stages of development in the entire stand. Even-aged stands have specific developmental stages which are evident because only one general age category is present at a time.

Developmental Stages of Even-Aged Stands

1. Seedling stage — From seed to 5 to 15 years, when the stand begins to close. (Trees less than one inch in diameter and up to three feet tall)
2. Sapling stage — From the closing of the stand to the death of lower limbs, with crowns well above the ground. (Small saplings - one to three inches in diameter and up to ten feet in height)
3. Pole stage — From the sapling stage through limb clearing of most of the stem. (Large saplings - three to five inches dbh)
4. Young timber stage — Mature height of the tree is attained. (Small poles - five to eight inches dbh)
5. Mature timber stage — From the stage of height growth completion to the start of the decline in quality and volume. (Large poles - eight to 12 inch dbh)
6. Overmature timber stage — From the start of deterioration in the stand to a decline in quality and volume. (Saw timber - over 12 inches dbh)

INFORMATION SHEET #13

Silvicultural Practices

Silviculture is the application of cutting practices to forest stands to increase their productivity.

Types of Silvicultural Cuttings

1. Intermediate cutting — Harvesting timber at any time from the reproduction stage to timber maturity. The principal objectives of intermediate cuttings are:
   a. The improvement of the existing stand.
   b. The regulation of tree and stand growth.
   c. Taking an opportunity for early financial returns.
   d. The reduction of conditions favorable for forest pests.
   e. The creation of conditions favorable to reproduction.
2. Thinning — A form of intermediate cutting in immature or young trees which improves the yield of the stand as a whole. The principle objectives of thinning are:
   a. To regulate the distribution of growing space for the remaining trees.
   b. To utilize to the best financial advantage all the merchantable material produced by the stand during its rotation.

   Various methods or techniques have been developed for thinning timber. Thinning methods include:

   a. Low thinning — Trimming small, short trees in the stand (trimming from below).
   b. Crown thinning — Removing the taller trees in the stand to open up the canopy (trimming from above).
   c. Selection thinning — Harvesting the best trees in the stand.
3. Cleaning — A method used to free the desired trees from competition from undesirable trees. Types of cleaning methods are as follows:
   a. Prescription burning — The use of fire under carefully controlled conditions is the most economical cleaning tool in young pines. Prescription burning is effective in controlling scrub hardwood up to four inches dbh on pine sites.
   b. Cutting — Cutting has limited use as a cleaning method because of the amount of labor involved.
   c. Basal spraying — The application of herbicides to the bark around the tree base is a very selective and reliable method, but an expensive one for cleaning.
   d. Foliage spraying — The spraying of hardwood foliage with herbicides is effective for broadcast control methods.
   e. Sterilants — Sterilants are gaining increasing popularity for sight treatments prior to planting. The chemicals generally persist in the soil for a year or more, so planting is delayed.
4. Liberation cutting — A form of cutting designed to free a young stand from competition from older trees. Overtopping is usually done to clear the canopy. There are several methods for controlling older, inferior trees:
   a. Girdling — Involves cutting through the bark and cambium and into the sapwood with an axe or mechanical tool.
   b. Basal spraying — The application of herbicide to the bark around the tree base.
5. Improvement cutting — Done to improve the stand's composition, quality, and condition by removing inferior trees. Improvement cuttings are generally used in older stands that have not had the benefit of cleanings or liberation cuttings. An

improvement cutting should precede a harvest cut by a significant number of years. Types of improvement cuttings are:

   a. Sanitation cutting — A form of cutting used to remove trees with insects or infected by diseases.

   b. Salvage cutting — Much like sanitation cuttings except salvage cut trees have a salable value.

   c. Pruning — The removal of side branches from trees to produce knot-free lumber for high-quality logs.

6. Harvest cutting — A silvicultural practice involving the removal of the mature timber, establishment of reproduction, and supplemental treatments of the timber-growing site. The methods of harvest cutting are as follows:

   a. Clear cutting — In this method, virtually all the trees in the stand, both large and small, are cut.

   b. Seed tree cutting — Seed tree cutting is a form of clear cutting, except that the seed-bearing trees are left suitably dispersed throughout the harvest area.

   c. Shelterwood cutting — In this method, only a portion of the stand is removed at any one time. Its purpose is to obtain natural reproduction under the partial shelter of a number of seed trees.

   d. Selection cutting — This is a complex method of cutting and removing individual trees throughout the stand based on maturity, growth rate, diameter, and vigor.

INFORMATION SHEET #14

Methods of Reforestation

Nationwide there is a great need for forest planting. Mismanaged woodlands, forests that have been burned, and abandoned cropland are types of land that need to be replanted with trees. There are five methods by which forests may be reproduced. They are as follows:

1. Use of wild seedlings — Wild seedlings are those growing in the woods naturally. The digging up and transplanting of such seedlings for reforestation purposes should be avoided. Such practices are uneconomical and inefficient.

2. Direct seeding — Direct seeding is the sowing of repellent-coated seed on an area where trees are desired. Direct-seeded pines grow as well as planted pines of the same age. Large areas can be seeded broadcast by hand, airplane, or cyclone seeder.

3. Cuttings — Some tree species such as willow or cottonwood can be reproduced by cuttings. Cuttings are pieces of branches, usually 8 to 12 inches in length, cut from a tree. Cuttings are usually taken from trees in the winter and planted shortly thereafter.

4. Nursery seedlings — The planting of nursery seedlings is the most certain method of acquiring a good stand. Chief advantages of planting are close control of stocking, uniformity of resulting stands, and conservation of seed.

5. Containerized seedlings — By this method seeds are germinated in small pots of soil. After a period of 8 - 32 weeks, the seedlings are planted with undisturbed roots.

INFORMATION SHEET #15

Tree Planting

Estimate needs — It is very important to order the proper number and species of trees required for the area to be reforested.

Care of seedlings upon receipt from nursery — It is important that seedlings be planted as soon as possible upon receipt from the nursery. If planting must be delayed because of weather, the seedling bales should be opened and the trees heeled in at the planting site.

Tree spacing — The choice of spacing of pine trees is dependent upon the owner's objective. A spacing of 6 x 8 feet or 8 x 8 feet favors maximum cubic feet volume growth. A spacing of 8 x 12 feet is needed to permit passage of trucks or other equipment. Spacings of 10 x 10 feet or 12 x 12 feet may be used when trees of large diameter are desired in a relatively short time.

Planting procedure — As a rule, about 75 to 80 percent of all properly planted seedlings will survive. The three major methods of planting seedlings are hand planting, bar planting, and machine planting. Whether planting pine seedlings with a machine or by hand, there are certain procedures that must be followed.

1. Plant the seedling slightly lower, never higher, than it grew in the nursery.
2. Plant seedlings in an upright position with the roots straight down.
3. Always pack soil firmly around the roots to hold trees in an upright position.
4. Plant only one tree in a given spot.

INFORMATION SHEET #16

Marketing Timber

Making a profitable timber sale is the best incentive to improve management of timber lands. Timber may be sold in several ways:

1. Lump sum — This refers to a payment made at one time for a total price of all products or trees to be sold.
2. Individual tree sales — This refers to sales made on the basis of so much per tree. Trees sold in this way are normally used in the production of high-value products such as veneer bolts, poles, and piling.
3. Tree scale — This refers to timber sold on the basis of so much per board foot or cord.
4. Loan scale — This refers to payment made on the basis of the measurement of the log at the mill or concentration point.
5. Weight — This refers to the sale of timber for a set price per ton weight of wood fiber.

Written Sales Contract

A written contract should be used to protect the interests of the timber grower as well as those of the timber buyer. A written contract should be simple but should include all the items agreed upon. A suitable contract may include some of the following points:

1. The names of the buyer and seller and a description of the property and its location.
2. The price and method of payment on the basis of species, products, and units of measurement.
3. The understanding that trees to be cut will receive tree paint marks of a specified color, one at the ground line and one at eye level.
4. The understanding that trees to be cut will be over the minimum top diameter specified by the contract.
5. The guarantee that the timber stand, other improvements, and the land will be protected by fire and excessive logging damage.
6. A specific termination date.
7. The title of the timber guaranteed by the seller.
8. Prohibition of the buyers reassigning the contract without the written consent of the seller.

INFORMATION SHEET #17

Forest Fire Control

Types of Forest Fires

1. Ground fires — Ground fires are those that burn organic materials such as needles, leaves, and twigs in various stages of decomposition.
2. Surface fires — Surface fires are those that burn surface litter of loose debris on the forest floor, and small vegetation.
3. Crown fires — Crown fires are those that burn from top to top of forest trees or shrubs. Crown fires are the fastest spreading of all types of fires.

Forest Fire Suppression

1. Presuppression — This refers to those advanced efforts made between the fire stands so that it can be readily controlled and extinguished.
2. Suppression — The basic jobs of fire suppression are to:
    a. Rob the fire of fuel.
    b. Reduce the fire's temperature.
    c. Cut off the oxygen from the fire.

Fire Fighting Methods

1. Direct method — When fires are small and slow burning, the fire is attacked at the burning edge or fire lane. The heat is usually low enough to permit fire fighters to work at the fire's edge.
2. Indirect method — Some fires are too fast burning and hot for fire fighters to work near the fire's edge. In this case, fire fighting involves cutting a fire break some distance from the fire and backfiring the intervening area.

INFORMATION SHEET #18

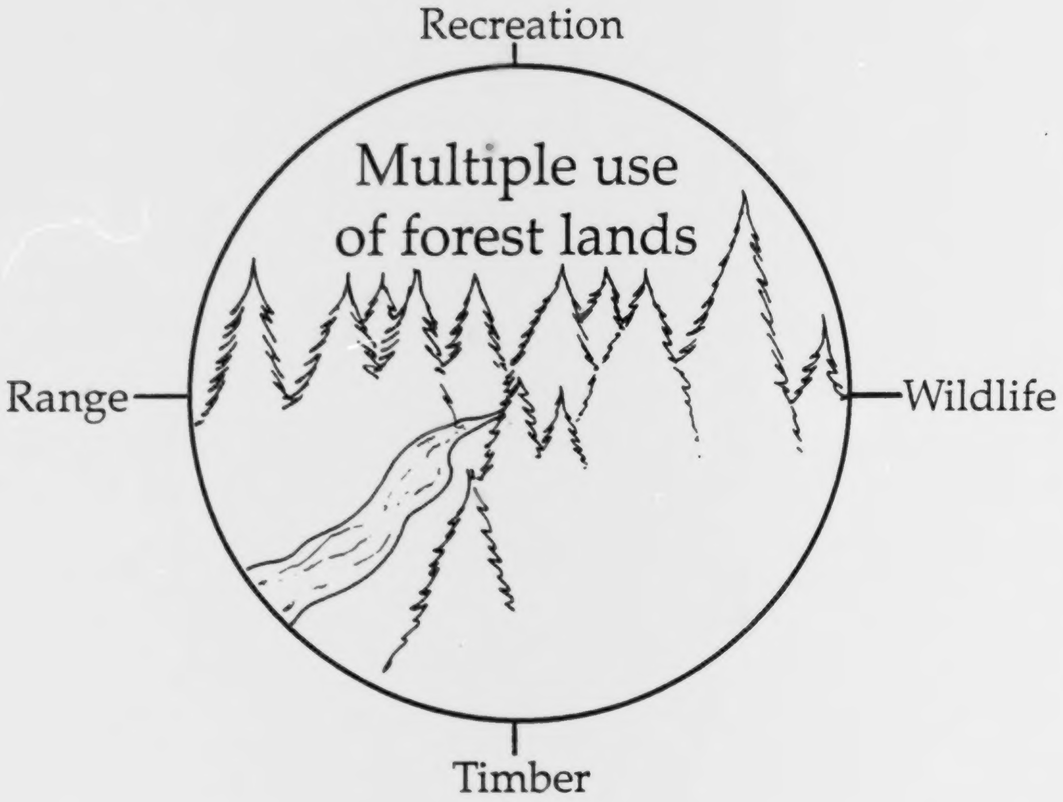
Forest Insects

Not all insects are harmful. Some are predators, seeking out and destroying destructive insect pests. Sometimes, tree-killing insects benefit man, but normally they are harmful. The study of forest insects, called forest entomology, involves an investigation of insect life cycles, damages caused by insects, and control techniques. Insect classification is done by the injuries they inflict and their feeding methods. The forest insect classifications are:

1. Bark beetles — Insects that tunnel under the bark through the cambium layer. This destruction of the phloem and cambium has a girdling effect on the tree and introduces wood-destroying fungi.
2. Leaf eaters — Insects that feed on the plant foliage by sucking plant sap or by eating the leaves.
3. Wood borers — Insects that bore into the wood, destroying the fiber and carrying fungi that stain and discolor the wood and cause it to rot.
4. Tip feeders — Insects that feed on the growing tips of plant branches. They eat the bark and bore into the wood, sometimes girdling the twig.
5. Cone and seed feeders — Cone, seed, and nut insects that attack the flowers, fruits, and seeds of almost all tree species.
6. Gall formers — Insects and mites that injure the plant tissue causing various types of abnormal swelling. These enlargements may interfere with the nutrient supply to the tree, causing stunted growth or reduced tree vigor.

TRANSPARENCY MASTER #1

Multiple Use of Forest lands


Recreation
Multiple use of forest lands
Range
Wildlife
Timber

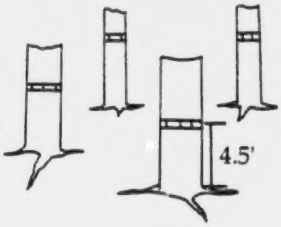
Adapted from : *Instructional Materials Service*

TRANSPARENCY MASTER #2

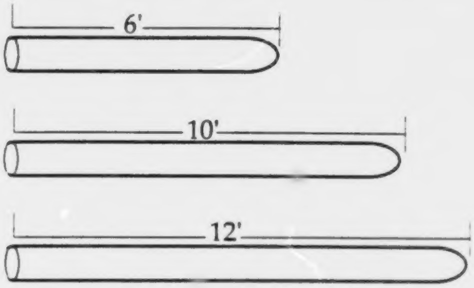
Measurement Units

Basal area

square feet of all trees or, an acre measured at D.B.H.



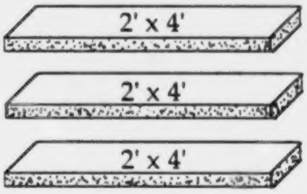
Linear feet



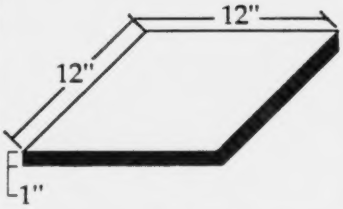
Piece

number of a specific dimension

(3) 2' x 4's

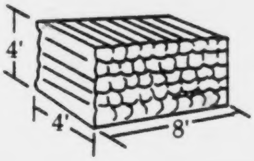


Board foot

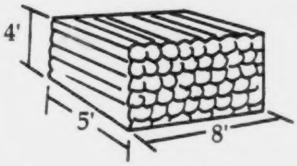


Cord

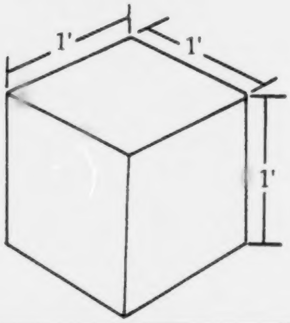
Standard cord



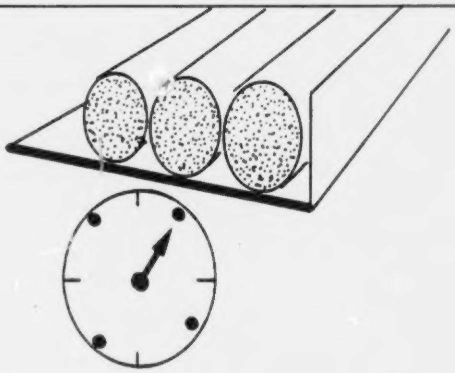
Long cord



Cubic foot



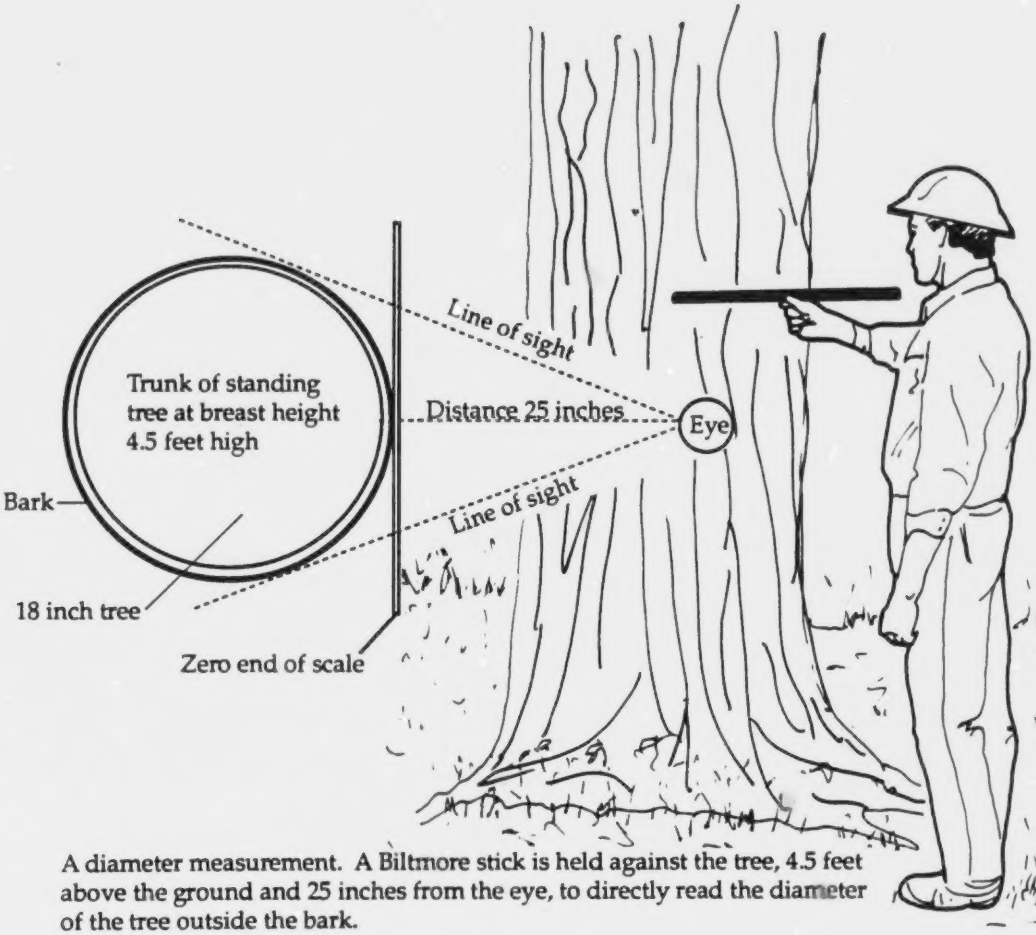
Weight



Adapted from : *Instructional Materials Service*

TRANSPARENCY MASTER #3

Measuring Diameter


Line of sight
Trunk of standing tree at breast height 4.5 feet high
Distance 25 inches
Eye
Line of sight
Bark
18 inch tree
Zero end of scale

A diameter measurement. A Biltmore stick is held against the tree, 4.5 feet above the ground and 25 inches from the eye, to directly read the diameter of the tree outside the bark.

TRANSPARENCY MASTER #4

Board Foot Volume of Trees* by Diameter and Height Classes

International Rule - Form Class 76

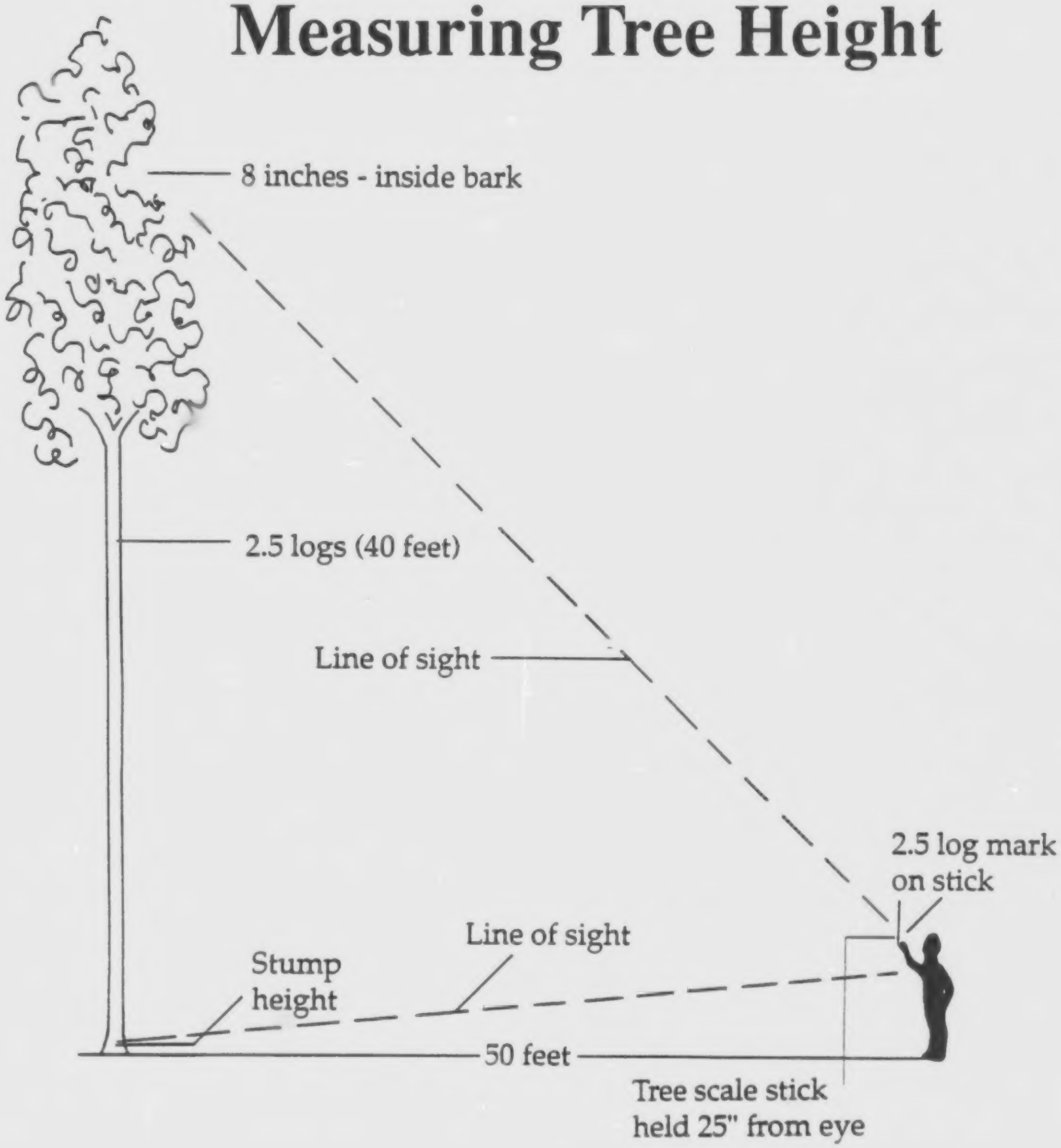
	Number of 16-Foot Logs in Trees						
dbh	½	1	1½	2	2½	3	3½
(inch)	Volume in Board Feet						
10	21	34	44	55			
12	30	52	68	85	98		
14	42	74	99	124	143	162	
16	59	100	134	169	198	226	246
18	74	129	175	221	259	297	325
20	92	162	220	279	328	377	413
22	112	198	271	344	406	467	514
24	133	237	326	415	491	567	622
26	158	284	392	500	592	684	755
28	187	331	458	585	696	806	888
30	220	381	529	677	805	933	1029
32	254	435	606	776	926	1077	1192
34	291	493	687	881	1054	1227	1359
36	333	559	782	1006	1205	1404	1557
38	374	624	874	1125	1354	1582	1754
40	415	693	974	1256	1510	1764	1962

*For estimating board feet in standing trees

Credit: University of Missouri Extension Service Agricultural Guide G05050

TRANSPARENCY MASTER #5 (Continued)

Measuring Tree Height


8 inches - inside bark
2.5 logs (40 feet)
Line of sight
2.5 log mark on stick
Line of sight
Stump height
50 feet
Tree scale stick held 25" from eye

Merchantable tree heights are measured using the hypsometer on the tree scale stick. The hypsometer is graduated in log lengths, usually 16 feet, so the observer can directly read the number of logs in a tree. Working on the principle of similar triangles, the stick must be held at the proper distance from the eye (usually 25 inches) when the observer is standing one chain, or 66 feet, from the tree. For accurate readings, the observer must also be standing on the same general elevation as the tree base. This illustration uses a 5-inch inside bark cut-off point rather than the 6- to 8-inch point suggested for saw timber and the 4-inch point for pulpwood.

TRANSPARENCY MASTER #6

International ¼" Log Rule Table

Diameter of log small ends, inside bark (inches)	Length of Logs (feet)				
	8 Bd. ft.	10 Bd. ft.	12 Bd. ft.	14 Bd. ft.	16 Bd. ft.
6	10	10	15	15	20
7	10	15	20	25	30
8	15	20	25	35	40
9	20	30	35	45	50
10	30	35	45	55	65
11	35	45	55	70	80
12	45	55	70	85	95
13	55	70	85	100	115
14	65	80	100	115	135
15	75	95	115	135	160
16	85	110	130	155	180
17	95	125	150	180	205
18	110	140	170	200	230
19	125	155	190	225	260
20	135	175	210	250	290
21	155	195	235	280	320
22	170	215	260	305	355
23	185	235	285	335	390
24	205	255	310	370	425
25	220	280	340	400	460
26	240	305	370	435	500
27	260	330	400	470	540
28	280	365	430	505	585
29	305	385	465	545	630
30	325	410	495	585	675

Credit: University of Missouri Extension Service Agricultural Guide G05050

TRANSPARENCY MASTER #7

Cord Volume Table

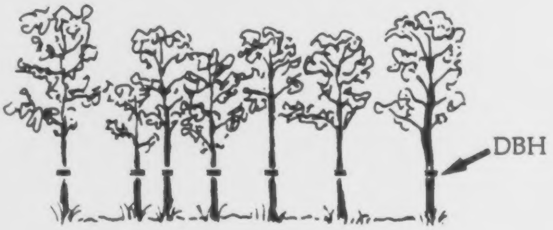
dbh (inches)	Height in Number of 8-Foot Bolts					
	1	2	3	4	5	6
	Volume in Cords - Unpeeled					
6	.02	.03	.04	.06		
8	.03	.05	.07	.09	.12	.14
10	.05	.07	.10	.13	.17	.20
12	.07	.10	.14	.18	.22	.27
14	.10	.13	.18	.23	.29	.35
16	.12	.17	.22	.29	.36	.44
18		.20	.27	.35	.44	.53
20		.25	.32	.42	.52	.63

Taken from Technical Note 202, Lake States Forest Experiment Station, University Farm, St. Paul, Minnesota, 1943. Volume is stem volume above one foot stump in standard unpeeled cords (standard cord is 4' x 4' x 8'). Height is number of usable 8-foot bolts to a variable top diameter, not less than four inches inside the bark.

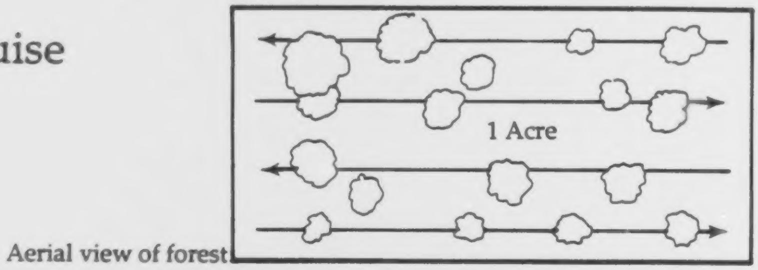
TRANSPARENCY MASTER #8

Timber Cruising

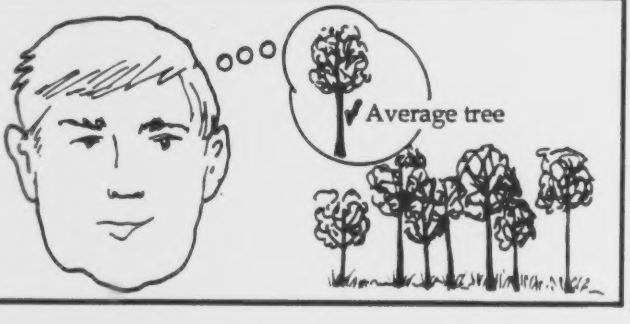
1. 100% or total cruise



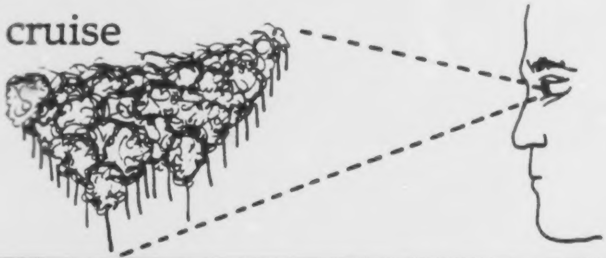
2. Partial cruise


1 Acre
Aerial view of forest

3. Average tree cruise


Average tree

4. Ocular or "eyeball" cruise



Adapted from : *Instructional Materials Service*

TRANSPARENCY MASTER #9

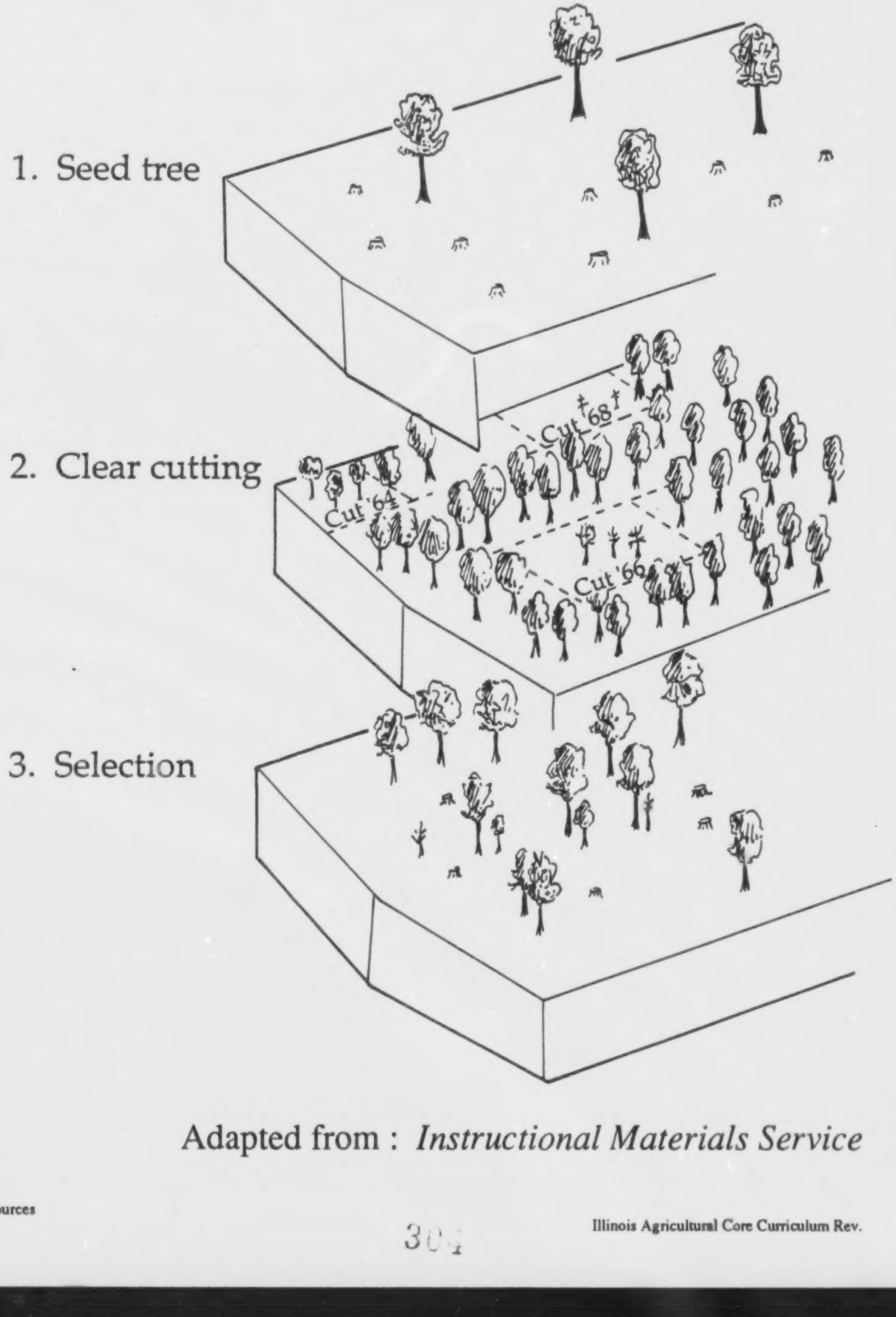
Non-Professional Careers in Forestry

1. Choker setter
2. Forestry aide
3. Jobber
4. Logger
5. Logging operator
6. Log scaler
7. Lumber checker
8. Lumber grader
9. Machinery and equipment repairman
10. Machinery operator
11. Millwright
12. Nurseryman
13. Pole inspector
14. Pole treating supervisor
15. Pole yard manager
16. Pulpwood dealer
17. Pulpwood yard manager
18. Pulpwood yard supervisor
19. Sales and service manager
20. Sawmill equipment operator
21. Sawmill manager
22. Scaler and grader
23. Timber buyer
24. Timber cruiser
25. Timber cutter
26. Timber marker
27. Timber producer
28. Truck driver
29. Woods supervisor

Adapted from : *Instructional Materials Service*

TRANSPARENCY MASTER #10

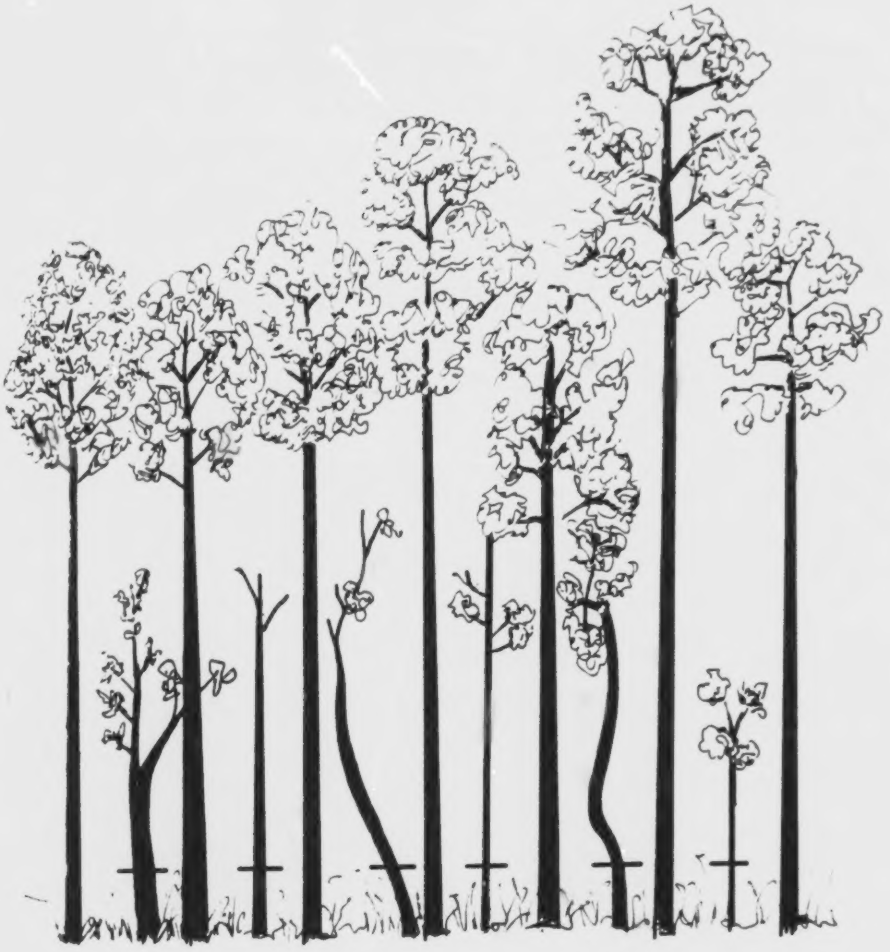
Principal Harvest Cutting Methods


1. Seed tree
2. Clear cutting
Cut '68
Cut '64
Cut '66
3. Selection

Adapted from : *Instructional Materials Service*

TRANSPARENCY MASTER #11

Improvement Cutting



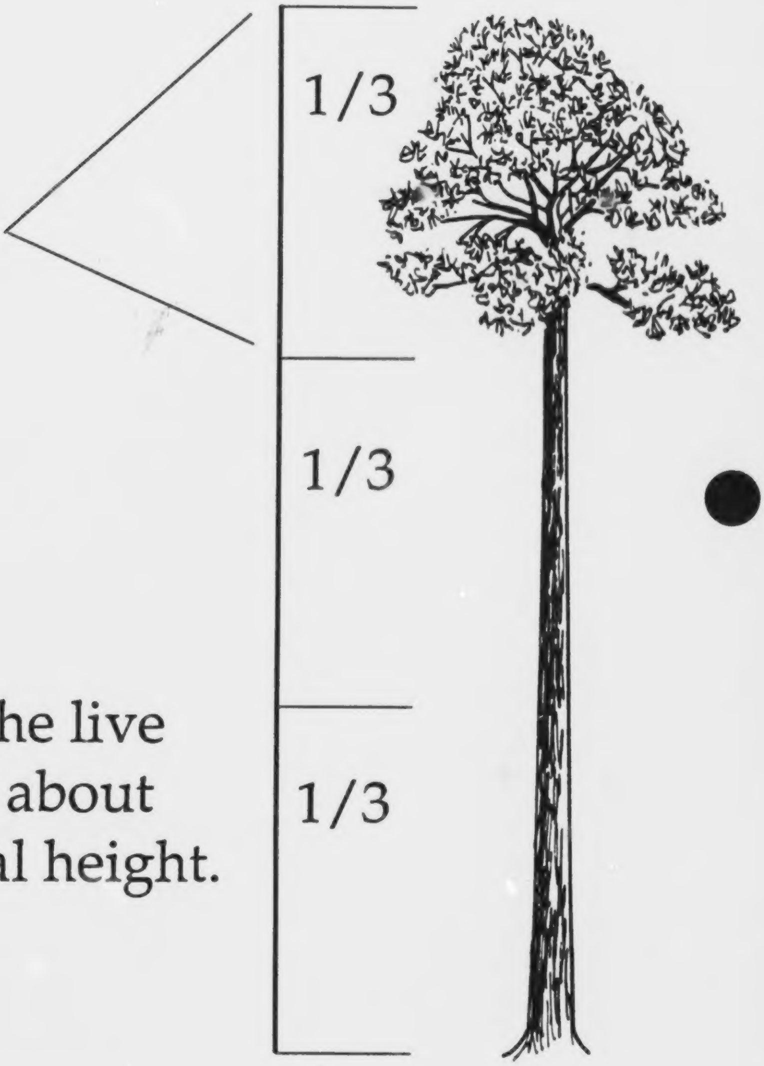
Remove dead, dying, crooked, diseased, insect infested, poor trees

Adapted from : *Instructional Materials Service*

TRANSPARENCY MASTER #12

Techniques for Thinning

Live crown ratio

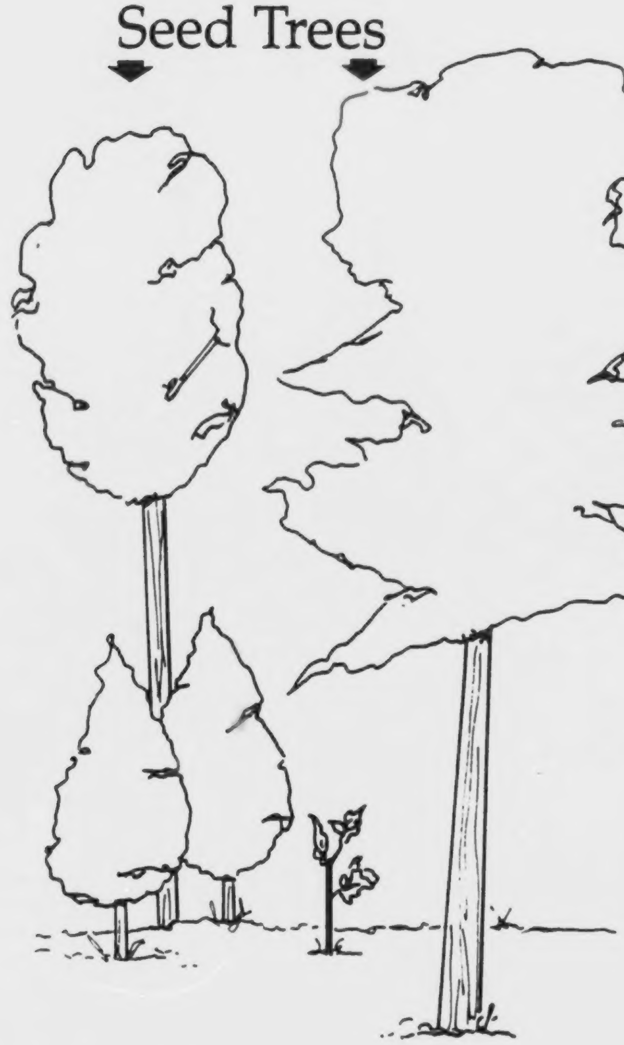


For pine stands the live crown should be about one-third the total height.

Adapted from : *Instructional Materials Service*

TRANSPARENCY MASTER #13

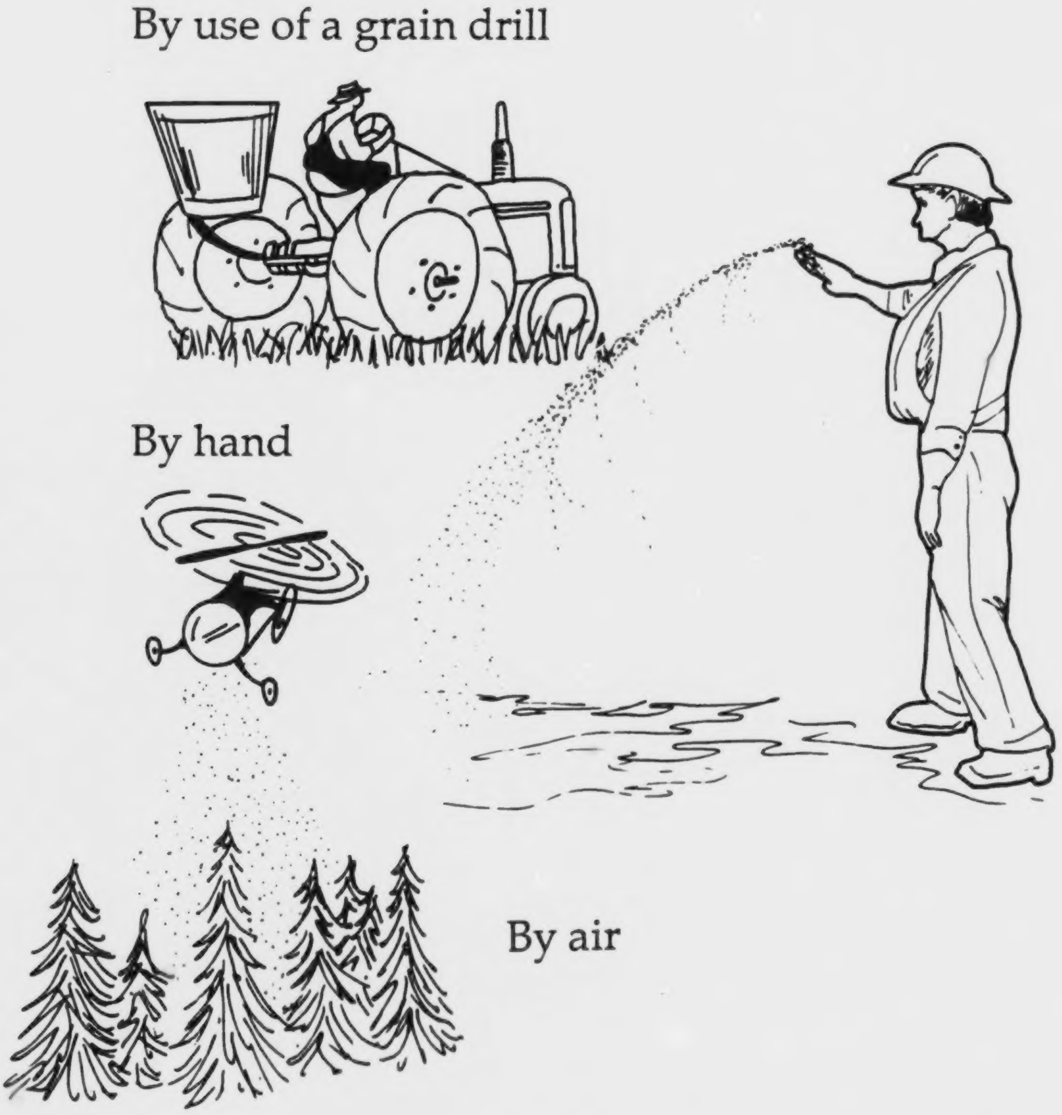
Natural Seeding



Adapted from : *Instructional Materials Service*

TRANSPARENCY MASTER #14

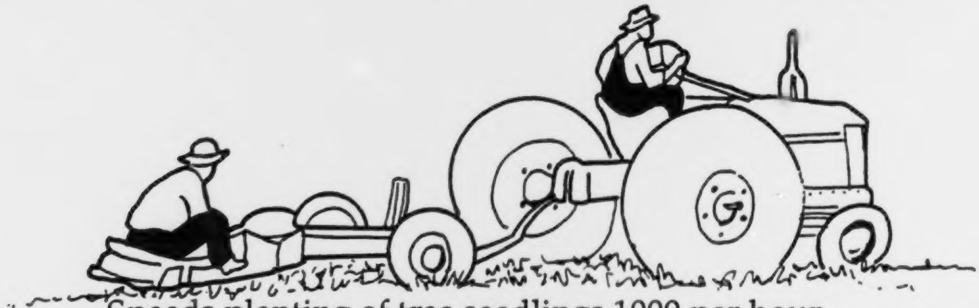
Methods of Direct Seeding


By use of a grain drill
By hand
By air

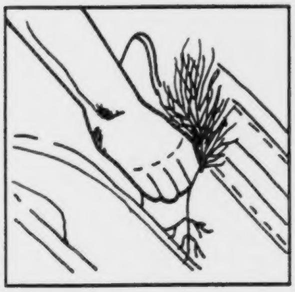
Adapted from : *Instructional Materials Service*

TRANSPARENCY MASTER #15

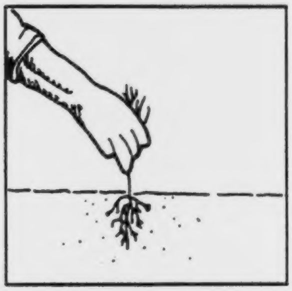
Mechanical Tree Planting



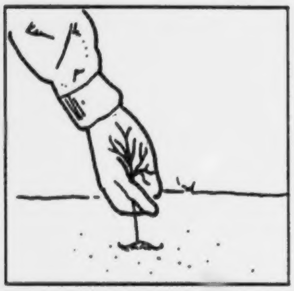
Speeds planting of tree seedlings 1000 per hour



Place seedling forward in trench

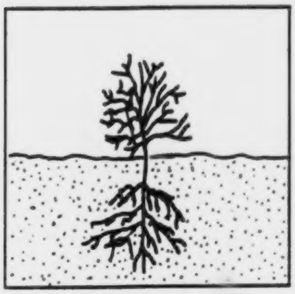


Set seedling at correct depth, release while straight up

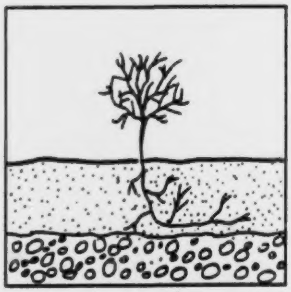


Hold seedling until soil closes around root, wheels pack soil

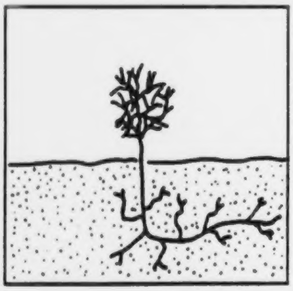
Protect plantings from fire ——————— Keep seedlings moist



Correct depth



Trench too shallow



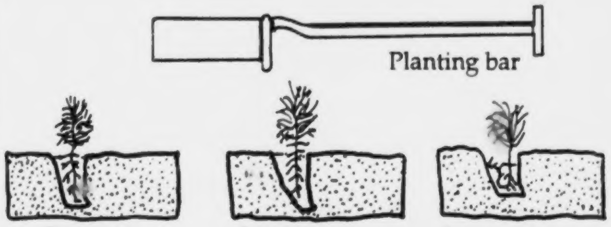
Seedling dragged along in trench causes poor root development and loss.

Adapted from : *Instructional Materials Service*

TRANSPARENCY MASTER #16

Use of Planting Bar in Hand Planting

Planting Depths

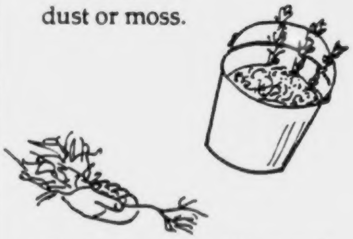


Correct: seedlings with root collar 2" below ground level, roots

Incorrect: root colar too high

Incorrect: U-shaped roots may cause poor survival

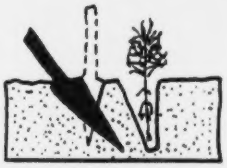
Carry seedlings in bucket filed with wet saw-dust or moss.



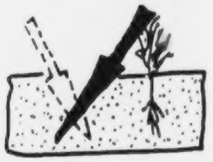
Do not carry seedlings with roots exposed to sun or wind.

Important: Do not let roots dry out.

On Tight Soils

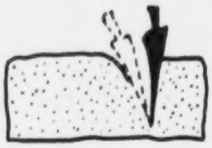


Pull handle of planting bar toward planter to firm soil around root end



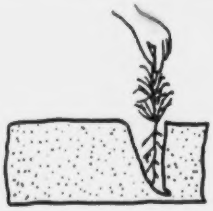
Push handle of planting away from planter to firm soil at roots top

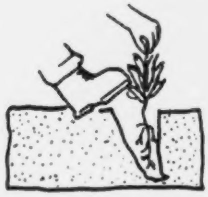
On Sandy Soils



Insert planting bar straight down, pull backward to open hole, remove bar

Place seedling at correct depth



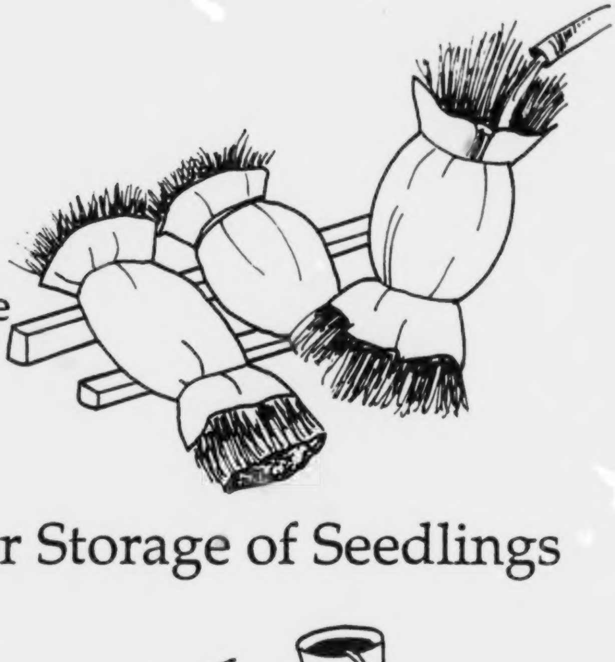


Fill in hole by firming with heel

Adapted from : *Instructional Materials Service*

TRANSPARENCY MASTER #17

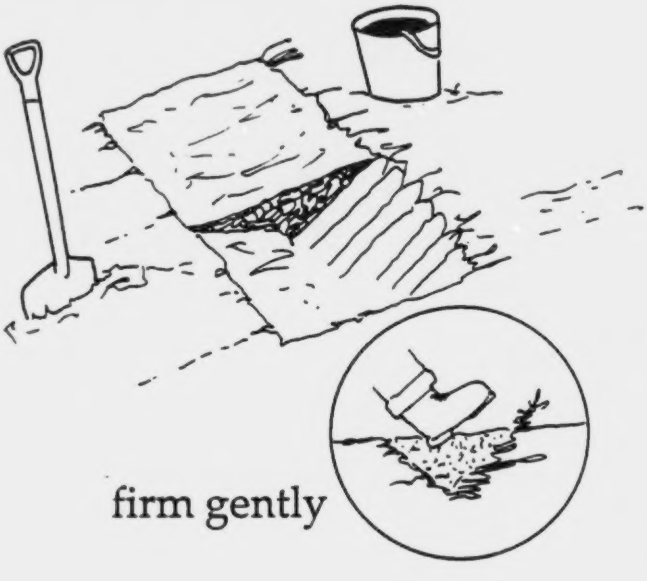
Recommended Method for Care and Storage of Seedlings



Package storage
- avoid freezing
- allow ventilation
- keep moist
- raise one end for drainage
- store in cool shady place

Alternate Method for Storage of Seedlings

Heeling in
- dig V-shaped trench
- break bundles
- spread seedlings
- cover roots with soil
- dampen with water



Adapted from : *Instructional Materials Service*

TRANSPARENCY MASTER #18

Uses of Trees

Tree or shrub	Wood Products	Wildlife control	Windbreaks	Erosion	Ornamental or shade
Aromatic sumac		X		X	
Autumn olive		X	X	X	X
Bald cypress	X			X	X
Black locust	X (Fence posts)			X	
Black walnut	X	X			
Cottonwood	X			X (Strip mines, stream banks)	
Dogwood		X			X
European black alder		X	X	X	X
Green ash	X		X	X	X
Hackberry	X	X	X		X
Jack pine		X (Cover)	X	X	
Lilac			X	X	X
Loblolly pine	X			X (Ozarks, strip mines)	
Ninebark			X		X
Northern red oak	X	X			X
Osage orange	X	X	X	X	
Pecan	X	X		X (Strip mines)	X
Persimmon		X			
Pin oak		X	X		X
Redbud			X	X	X
Red cedar	X	X (Cover)	X	X	X
River birch				X	X
Russian olive		X	X		
Scotch pine	X (Christmas Trees)	X (Cover)	X		X
Shortleaf pine	X			X (Ozarks)	
Silver maple	X				
Sweet gum	X		X (Boot heel)		X
Sycamore	X			X (Stream Banks)	X
White mulberry		X			X
White pine	X		X		X
Wild plum		X		X	
Yellow poplar	X				X

Credit: University of Missouri Extension Service Agricultural Guide G05006

TRANSPARENCY MASTER #19

Planting Forest Trees

Tree and Shrub Planting Guide

Tree		Rows Apart (feet)	Spacing in Rows (feet)
Pine: Shortleaf, Loblolly, Scotch, White, Jack, Austrian (wildlife)		10	10
Pine: Scotch, White (Christmas tree)		-variable-	
Walnut Pecan Green Ash N. Red Oak Yellow Poplar	Cottonwood Cypress Silver Maple Pin Oak Black Cherry	15	15
Mulberry Black Alder Black Locust	Hackberry	14	12
Osage Orange		(hedgerow)	4

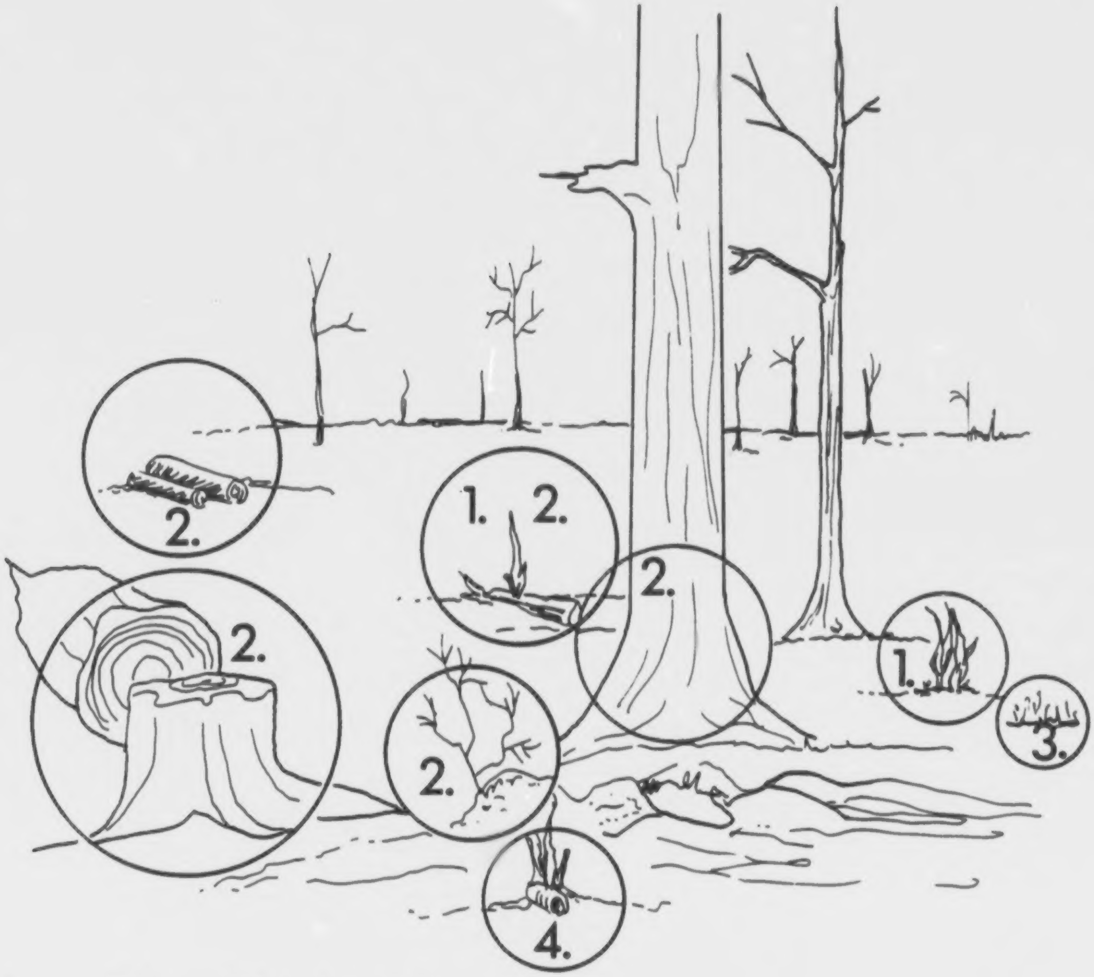
Number of Trees/Acre for a Given Spacing

6 x 6 = 1,210
7 x 7 = 889
8 x 8 = 681
9 x 9 = 538
10 x 10 = 436
12 x 12 = 302
15 x 15 = 194
20 x 20 = 108

TRANSPARENCY MASTER #20

"Mopping Up" After a Fire

After fire has been controlled, "mop up" before leaving it



1. Put out all burning spots

2. Move logs, cut trees, or snags near fireline

3. Spread fuel near firelines

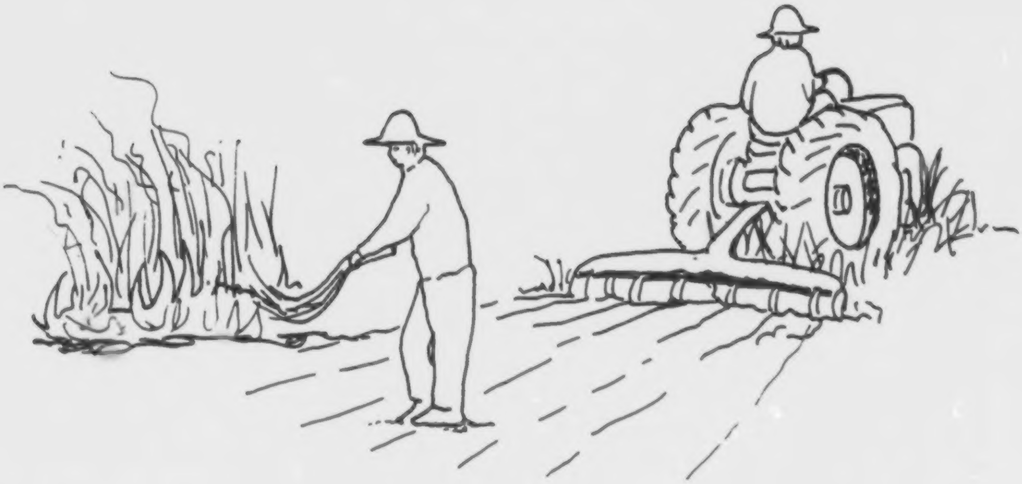
4. Patrol firelines to see that no burning roots or other materials cross over

Adapted from Instructional Materials Service

TRANSPARENCY MASTER #21

Indirect Fire Fighting

Firebreak Construction



Plow firebreak to bare mineral soil. Burn out area between oncoming fire and the plowed firebreak. Allow enought distance between tractor and oncoming fire for safety.

Plow firebreak to bare mineral soil. Burn out area between oncoming fire and the plowed firebreak. Allow enough distance between tractor and oncoming fire for safety.

Adapted from Instructional Materials Service

TRANSPARENCY MASTER #22

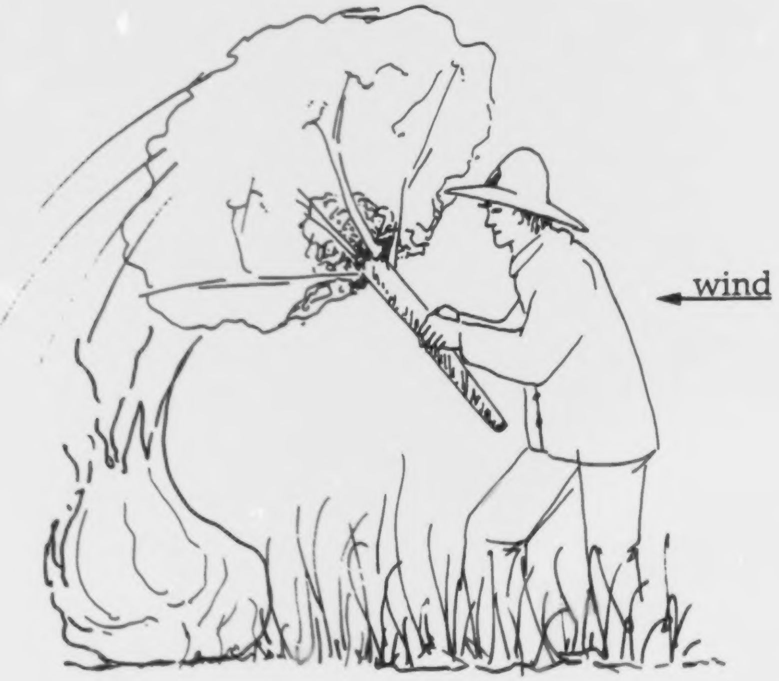
Direct Fire Fighting

Field or grass fires

Use swatter,
green tree branch,
or wet sack

Includes:
swatting, watering,
and smothering at
the burning edge

Swing toward fire



Forest Fires

Work on or near the fire: use no backfire

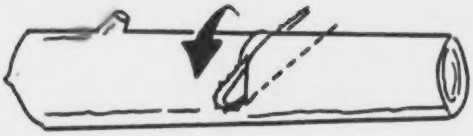
Adapted from Instructional Materials Service

TRANSPARENCY MASTER #23

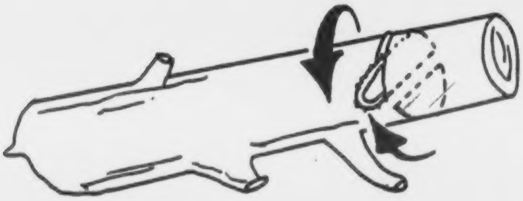
Safe Bucking Procedures

Use these bucking procedures for safety

A. Log Lying Flat
Cut from top (overbuck)
Avoid cutting into earth

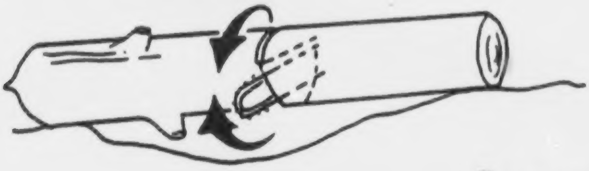


B. Work Supported at One End
Second cut overbuck (2/3 of the diameter)
to meet the first cut (to avoid pinching)



First cut underbuck
(1/3 of the diameter) to
avoid splintering

C. Work Supported on Both Ends
First cut overbuck

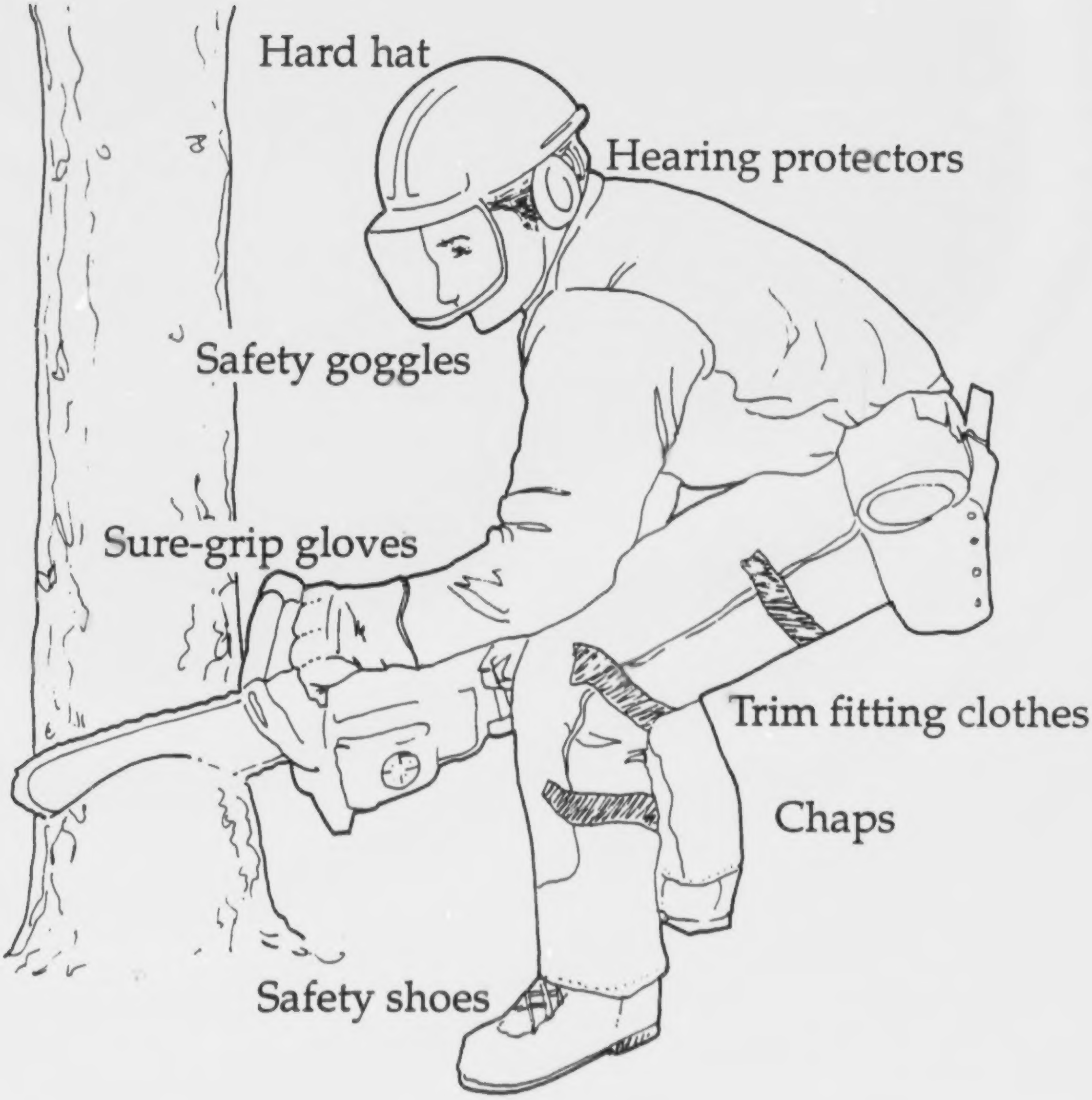


Second cut underbuck

317

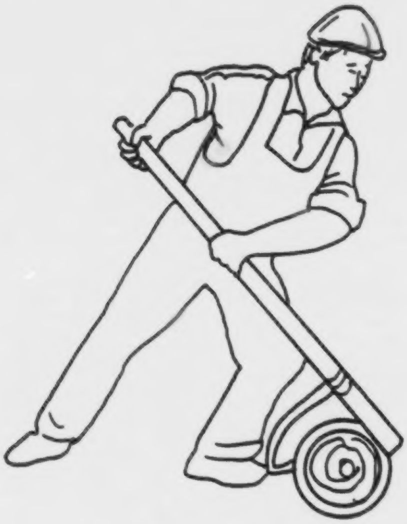
TRANSPARENCY MASTER #24

Chain Saw Safety

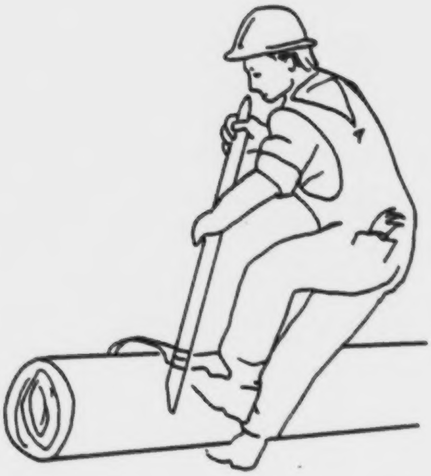

Hard hat
Hearing protectors
Safety goggles
Sure-grip gloves
Trim fitting clothes
Chaps
Safety shoes

TRANSPARENCY MASTER #25

Using the Cant Hook



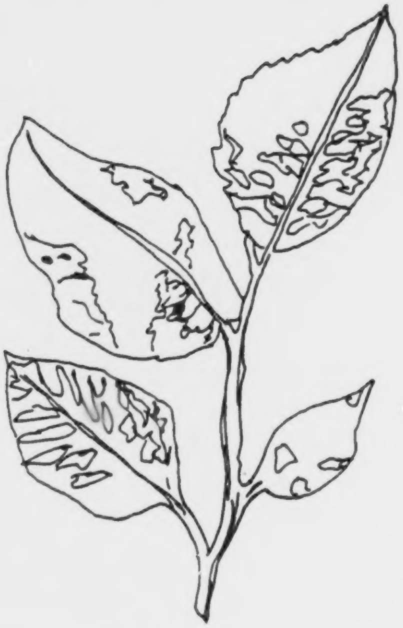
A. The safer way



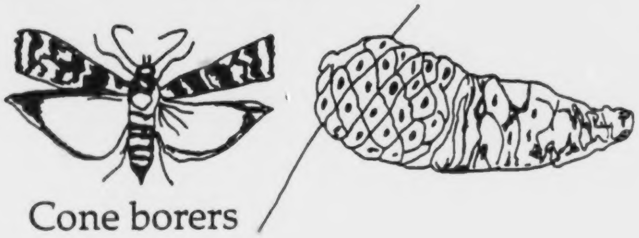
B. Rolling logs towards you is dangerous

TRANSPARENCY MASTER #26

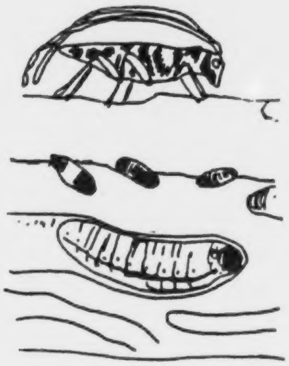
Types of Forest Insects Based on Tree Damage

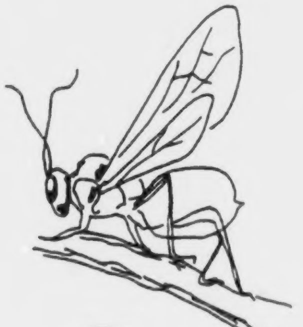


Leaf eaters

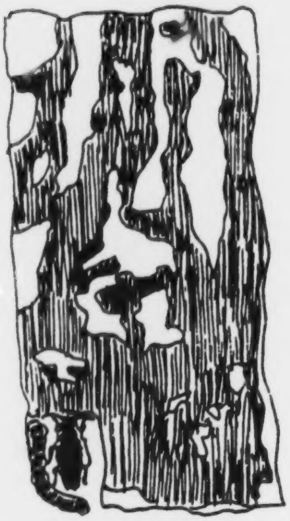


Cone borers

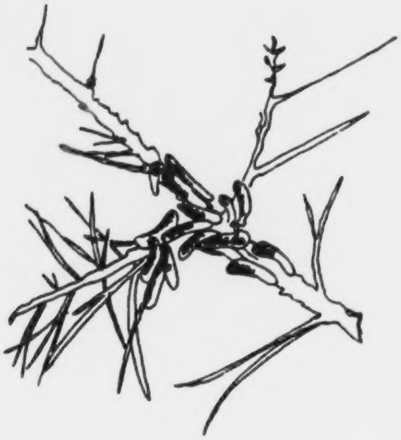




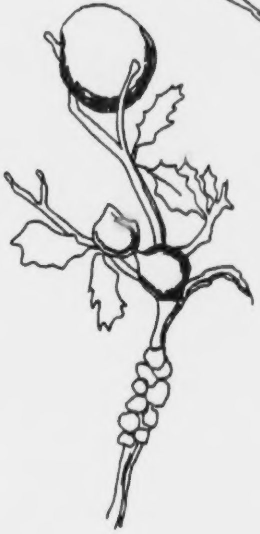
Wood borers



Bark beetles



Tip feeders



Gall formers

Adapted from Instructional Materials Service

STUDENT ACTIVITIES

STUDENT WORKSHEET #1 — Test

For additional activities, teachers may refer to the "Suggested Teaching Activities and Procedures" section in the Instructor's Guide.

STUDENT WORKSHEET #1

Test

1. List five beneficial influences of trees.
    a.
    b.
    c.
    d.
    e.
2. What are seven ways in which the volume of wood in a tree or tree stand can be measured?
    a.
    b.
    c.
    d.
    e.
    f.
    g.
3. List the steps in measuring usable tree height.
4. List the steps in measuring dbh.
5. List and describe the two methods of timber cruising.
    a.
    b.
6. What is the difference between a physical and biological environmental factor?
7. List and describe the seven tree developmental stages.

8. What is the purpose of performing silvicultural practices on a timber stand?

9. What is meant by reforestation?

10. List and describe the five methods by which trees may be marketed.

    a.
    b.
    c.
    d.
    e.

11. What should be included in a written timber sales contract?

12. What are the three types of forest fires?

    a.
    b.
    c.

13. What are the two fire fighting methods used to control forest fires?

14. Name and describe the six classifications of forest insects.

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Forestry

PROBLEM AREA: Producing Christmas Trees

RELATED PROBLEM AREAS:

1. Identifying Trees and Forestry Products
2. Managing Forestry Resources
3. Processing Forest Products
4. Managing Land Resources
5. Understanding and Maintaining Small Engines (Agricultural Business and Management Cluster)
6. Marketing Agricultural Products and Services (Agricultural Business and Management Cluster)

PREREQUISITE PROBLEM AREA(S):

1. Classifying Trees
2. Managing Entrepreneurship Opportunities and Agriculture (Agricultural Business and Management Cluster)

LEVEL: Preparatory

OCCUPATIONAL TASKS ADDRESSED:

Agricultural Resources Cluster

Duty A: Managing the Recreational Facility

1. Complete weekly receipts
2. Complete invoices
3. Requisition materials, supplies, and services
4. Maintain inventory records
5. Maintain equipment maintenance records
6. Follow work schedule
7. Contribute to annual park management update
8. Complete business forms
9. Communicate orally with visitors
10. Assist in assessing and collecting fees and charges
11. Determine land-use capability
12. Assist in development of resource conservation plans

Duty B: Applying Laws, Regulations, and Policies

1. Request visitors to voluntarily comply with rules and regulations
2. Process visitor complaints
3. Maintain crowd control
4. Direct vehicular and pedestrian traffic
5. Greet and meet people
6. Prepare service work order
7. Post facility directions and warnings
8. Maintain permits, certificates, and licenses

Duty C: Performing Promotional Activities

1. Conduct a visitor's program and tour
2. Register visitors
3. Give information and directions in a variety of formal and informal settings
4. Lead or guide recreational activities
5. Stimulate interest and participation in recreational activities for special groups

Duty E: Performing General Office Work

1. File materials such as receipts, letters, documents, specifications, and orders
2. Process incoming telephone calls
3. Process outgoing telephone calls
4. Clean work areas
5. Make minor office equipment repairs

Duty F: Using Tools, Materials, and Equipment

1. Maintain grounds using power tools
2. Maintain grounds using power equipment
3. Use hand tools

Duty G: Assembling, Servicing, and Maintaining Equipment and Facilities

1. Follow a facility and grounds maintenance schedule
2. Maintain grounds and recreational areas

Duty H: Applying Safety Practices

1. Monitor equipment for safe operation

STATE GOALS FOR LEARNING

In planning the instruction for this problem area, teachers can promote the development of several student learning objectives which are related to the State Goals for Learning in Biological and Physical Sciences and Social Sciences. These objectives are listed on the Learning Assessment Plan forms included on the following page(s). Those learning objectives marked with an asterisk (*) are taken from the sample lists provided by the Illinois State Board of Education.

CORE

Illinois Agricultural Core Curriculum

Agricultural Education 124 Mumford Hall 1301 W. Gregory Drive University of Illinois Urbana, IL 61801

Director: Dale A. Law, Ed.D.
Principal Investigator: Jerry D. Pepple, Ed.D
Research Assistant: Kevin J. Enderlin

Illinois Agricultural Core Curriculum Rev.

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

Submission Date ____________
☐ **Original submission** ☐ **Revision**
Page ____ of ____

I. LEARNING AREA *(check one)*
☐ Language Arts ☐ Fine Arts
☐ Mathematics ☐ Social Sciences
☒ Sciences ☐ Physical Development/Health

(Affix label or complete district information.)

COUNTY	DISTRICT	ESC

District Name

City

Contact Person: ____________
Title: ____________
Phone: ( )

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will have a working knowledge of the social and environmental implications and limitations of technological development.

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Relate advertising techniques to consumer demands.					
*2. Recognize the variety of Illinois' natural areas and relate them to economics and recreation.					
3. Develop a marketing plan for Christmas trees produced.					
4. Select the site best suited for Christmas tree production.					

Producing Christmas Trees

Agricultural Resources
Forestry

ISBE 41-78 (1/88)

Submission Date ____________ ☐ Original submission ☐ Revision	Page ____ of ____

I. LEARNING AREA *(check one)*

☐ Language Arts
☐ Mathematics
☒ Sciences
☐ Fine Arts
☐ Social Sciences
☐ Physical Development/Health

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

(Affix label or complete district information.)

COUNTY	DISTRICT	ESC

District Name
City

Contact Person: ____________
Title: ____________
Phone: (   )

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will have a working knowledge of the concepts and basic vocabulary of biological, physical, and environmental sciences and their application to life and work in contemporary technological society.

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Know the principle environmental factors that limit the distribution of plants and animals.					
*2. Recognize that one population of organisms can affect another.					
*3. Compare living organisms by applying a classification scheme.					
4. Identify the Christmas tree species that will grow in Illinois.					
5. Identify the cultural practices in Christmas tree production.					
6. Prepare the site for Christmas tree seedlings.					

ISBE 41-78 (1/88)

Producing Christmas Trees

Illinois Agricultural Core Curriculum Rev.

Agricultural Resources
Forestry

Illinois Agricultural Core Curriculum Rev.

Submission Date ____________
☐ Original submission ☐ Revision
Page ____ of ____

I. LEARNING AREA *(check one)*
☐ Language Arts ☐ Fine Arts
☐ Mathematics ☒ Social Sciences
☐ Sciences ☐ Physical Development/Health

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

(Affix label or complete district information.)

COUNTY	DISTRICT	ESC

District Name
City

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will be able to demonstrate a knowledge of world geography with emphasis on the United States.

Contact Person: ____________
Title: ____________
Phone: ( )

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Analyze the influence of site features and locational factors in land use.					
*2. Know reasons for different kinds of land use.					
3. Select a site best suited for Christmas tree production.					
4. Develop a plantation layout for the most efficient operation.					

Producing Christmas Trees

Agricultural Resources
Forestry

ISBE 41-78 (1/88)

ILLINOIS STATE BOARD OF EDUCATION
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100 North First Street
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LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

Submission Date ____________________
☐ Original submission ☐ Revision
Page _____ of _____

I. LEARNING AREA *(check one)*
☐ Language Arts ☐ Fine Arts
☐ Mathematics ☒ Social Sciences
☐ Sciences ☐ Physical Development/Health

(Affix label or complete district information.)

COUNTY	DISTRICT	ESC

District Name

City

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will be able to apply the skills and knowledge gained in the social sciences to decision making in life situations.

Contact Person: ____________________
Title: ____________________
Phone: (   )

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Understand the knowledge and skills required for success in selected fields of work.					
*2. Recognize that competence in a field of work entails the development of a wide range of skills.					
3. Prepare the site for Christmas tree seedlings.					
4. Select quality planting stock.					
5. Correctly plant Christmas tree seedlings.					
6. Harvest trees correctly for marketing.					
7. Develop a marketing plan for Christmas trees produced.					

ISBE 41-78 (1/88)

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Forestry

PROBLEM AREA: Producing Christmas Trees

STUDENT LEARNING OBJECTIVES

Upon completion of their study of this problem area, students will be able to:

1. Identify the Christmas tree species that will grow in Illinois.
2. Select a site best suited for Christmas tree production.
3. Prepare the site for Christmas tree seedlings.
4. Develop a plantation layout for the most efficient operation.
5. Select quality planting stock.
6. Correctly plant Christmas tree seedlings.
7. Follow protective measures to insure quality Christmas tree production.
8. Identify the cultural practices in Christmas tree production.
9. Harvest trees correctly for marketing.
10. Develop a marketing plan for Christmas trees produced.
11. Correctly formulate the costs and returns of producing Christmas trees.

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Forestry

PROBLEM AREA: Producing Christmas Trees

PROBLEMS AND QUESTIONS FOR STUDY	INSTRUCTOR'S NOTES AND REFERENCES
1. What are the Christmas tree species grown in Illinois?	
2. How does one select the site for Christmas tree production?	
3. What must be done to prepare the sight for planting?	
4. What are the steps in planting seedlings?	
5. What cultural practices are used to produce high-quality Christmas trees?	
6. What is the correct method to harvest Christmas trees?	
7. How does one market the Christmas trees one produces?	
8. How does one figure the profit generated from a Christmas tree production enterprise?	

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Forestry

PROBLEM AREA: Producing Christmas Trees

SUGGESTED TEACHING ACTIVITIES AND PROCEDURES

1. Visit a Christmas tree farm in your area.
2. Collect and identify Christmas tree branches of different species.
3. Start a Christmas tree lab.
4. Practice shearing and pruning on trees in the area or in the school-based lab.
5. Sell Christmas trees as an FFA fundraiser activity.
6. Prepare financial statements for a Christmas tree farm.
7. Order seedlings from the conservation department and practice planting them in the local community.
8. Collect cones, harvest seeds, and start trees from seed. (Growing Illinois trees from seeds, Cooperative Extension Service, circular #1219.)

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Forestry

PROBLEM AREA: Producing Christmas Trees

REFERENCES

INSTRUCTOR'S NOTES AND REFERENCES

*1. *Growing Christmas Trees in Illinois.* Illinois Cooperative Extension Service, Circular C1171.

2. *Choose and Cut Christmas Tree Farms.* Cooperative Extension Service, Leaflet #12.

3. *Agriculture Science II Curriculum.* University of Missouri-Columbia. 2316 Industrial Drive, Columbia, MO 65202. (800) 633-5937.

*4. *Ohio Agricultural Education Curriculum:*
311X, Ohio Christmas Tree Producers Manual;
308X, Insect Pests of Christmas Trees;
307X, Insect Control on Christmas Trees.
Materials Service, Room 254, 2120 Fyffe Rd., The Ohio State University, Columbus, OH 43210-1099.

*Indicates highly recommended reference

INSTRUCTIONAL RESOURCES

These resources are intended for use by teachers in planning and teaching the materials for this problem area and may be adapted to fit the teaching method(s) used.

INFORMATION SHEET #1 — Favored Christmas Tree Species in Illinois

INFORMATION SHEET #2 — Selecting the Site

INFORMATION SHEET #3 — Preparing the Site for Christmas Tree Seedlings

INFORMATION SHEET #4 — Planting Layout

INFORMATION SHEET #5 — Selecting Planting Stock

INFORMATION SHEET #6 — Planting Seedlings

INFORMATION SHEET #7 — Seedling Protection

INFORMATION SHEET #8 — Cultural Practices

INFORMATION SHEET #9 — Harvesting Christmas Trees

INFORMATION SHEET #10 — Marketing Christmas Trees

INFORMATION SHEET #11 — Costs and Returns

INFORMATION SHEET #12 — Illinois Christmas Tree Farms

TRANSPARENCY MASTER #1 — Planting Seedlings

TRANSPARENCY MASTER #2 — Common Terms for Christmas Tree Parts

TRANSPARENCY MASTER #3 — Desirable Tapers

TRANSPARENCY MASTER #4 — Christmas Tree Shaping

TRANSPARENCY MASTER #5 — Shearing Christmas Trees

TRANSPARENCY MASTER #6 — Costs for Planting Through Harvesting

INFORMATION SHEET #1

Favored Christmas Tree Species in Illinois

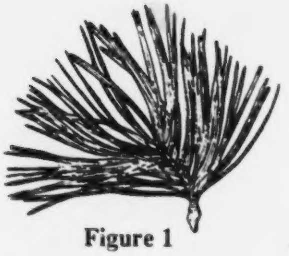


Figure 1

Scotch pine is native to Europe and Asia. Several varieties are successfully grown and marketed throughout Illinois. In general, strains of Scotch pine originating from seed obtained from central Europe have been more desirable than those from northern Europe, which tend to be susceptible to needle cast problems and to turn yellow in early winter. A number of nurseries have offered special strains of Scotch pine. These special strains might be more desirable for Christmas trees than other stock because similar seed are collected each year. The needles of this tree are in fascicles of two; better varieties are blue-green, 1 ½ to 3 inches long, slightly twisted, and sharp-pointed. The needles stay on the cut trees comparatively well. The branches are whorled and some varieties tend to develop a crooked stem. Scotch pine, which grows quickly, requires heavy pruning to develop a well-formed Christmas tree.

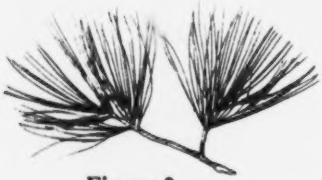


Figure 2

Eastern white pine is native to the extreme northern part of Illinois, but it grows well throughout the state. Because of the wide geographic range in which white pine grows, a number of desirable strains have been identified by Christmas tree growers. Because the supply of white pine seedlings from desirable geographical origins may vary from year to year, you should order the more desirable strains early. White pine has slender, flexible, bluish green needles two to five inches long with five needles per fascicle; needle retention is good. Eastern white pine tree grows rapidly and develops slender horizontal branches. It requires careful pruning for symmetry and the correct degree of compactness.

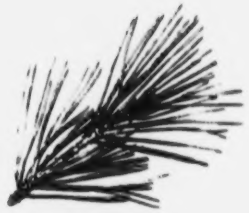


Figure 3

Virginia pine occurs naturally away from the Atlantic coastal plains from southern New York to northern Georgia and westward to northern Mississippi, with its range approximately bounded by the Ohio and Mississippi Rivers. The stiff needles are two per fascicle, about two inches long, yellow-green, and usually twisted. The foliage does not dry out rapidly and needle retention is good. Virginia pine is similar in appearance to Jack pine.

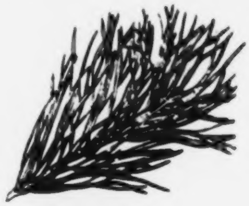


Figure 4

Colorado blue spruce is native to the Rocky Mountain region, but a limited number of trees are grown in northern Illinois. It is often used when a small Christmas tree is desired. Frequently the tree is dug, potted, and used indoors as a living Christmas tree, then planted outdoors as an ornamental. The needles are stiff, about one inch long, rather straight, blue-green to silvery green, and sharp-pointed. They extend at nearly right angles from all sides of the stout twig. Blue spruce has the best needle retention of all the spruces.

Douglas fir of southern Rocky Mountain origin is grown in limited quantities in northern Illinois where air drainage is good; otherwise it is subject to damage by late spring frosts. The needles of this tree are ¾ to 1 ¼ inches long, yellow-green or blue-green, soft and somewhat flattened, and they stand out from all sides of the twig. Douglas fir has excellent needle retention.

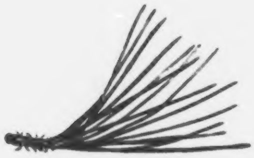


Figure 5

Red pine and Norway spruce were planted throughout Illinois in the past; but because of the poor needle retention characteristics of Norway spruce and the difficulty of shearing red pine, planting of these species has declined in recent years. Red pine often is used when a large tree (15 to 20 feet tall) is desired. White spruce and Fraser fir are planted on a limited basis: white spruce suffers from needle drop, and both species grow slowly compared to the favored Scotch pine and white pine.

The successful grower selects species adapted to the region in which the business is located, and plants more than one tree species to satisfy differences in consumers' preferences and to help prevent loss from insects or disease.

INFORMATION SHEET #2

Selecting the Site

Four Factors to Consider in Site Selection

1. Topography — Level to rolling land is best suited to Christmas tree production. The necessary cultural operations such as mowing, shaping, and harvesting are much easier if the land is not too steep or rugged. Furthermore, on steep areas it may be necessary to allow the trees to grow an additional year because the lower branches on the uphill side often develop poorly.

2. Wind Protection — The plantation area should be protected from excessive wind. Areas where the wind velocity is increased because of a funneling effect might break new leaders of the trees. Excessive wind also has a drying effect on the trees, and could kill those established on sandy areas. Excessive winds could cause snow to build up on branches of thick-needled pine species, causing them to break.

3. Air and Water Drainage — Select areas where air drainage is good to avoid late spring frosts and freezes, which are very harmful to trees, especially Douglas fir and the spruces. Good surface and internal soil drainage is necessary for successful growth of all Christmas tree species and for the operation of mechanical equipment.

4. Soils — Soil for growing Christmas trees should be neither too poor nor too fertile. Trees growing on poor soils usually have poor form, growth, and color, whereas trees established on very fertile soil grow too fast and require heavy pruning. Weeds and grass are likely to compete with the tree stand on very fertile soils. The ideal soil is slightly acidic, deep, relatively easy to work, and with an open texture that results in good internal drainage. If possible, avoid coarse sands, heavy clays with restrictive clay pans, or swampy areas.

You should select a location that is:

1. Large enough to include parking and storage areas, and possibly a retail lot.
2. Accessible to workers and machinery.
3. Close to your market.
4. Free of disease, insects, and fire hazards.
5. Protected against damage from wildlife.
6. Secure from vandals and thieves.

INFORMATION SHEET #3

Preparing the Site for Christmas Tree Seedlings

1. Eliminate vegetation growing on site where seedlings are to be planted.
    a. If woody growth covers more than one-third the area and cover is over eight feet in height, bulldozing gives the best results.
    b. If the area is mainly heavy grass, vegetation can be removed by disking.
    c. If the area is covered by low brush, herbicides are an effective method of preparing the site for planting.
2. Some land may require grading to fill small gullies.
3. Construct a road system.
    a. Roadways separating major blocks of trees should not be spaced over 200 feet apart.
    b. They should have an initial width of 15 feet because limb growth will reduce this space to around seven feet.

INFORMATION SHEET #4

Planting Layout

1. Items incorporated into planting layout include:
    a. location of roadways.
    b. row spacing.
    c. tree spacing within the row.
    d. direction of row.
2. Location of roadways should be such that all areas are readily accessible to vehicle travel during all seasons.
3. Row and tree spacing considerations include the following:
    a. spacing is dictated by mowing equipment and topography of the area.
    b. most growers use a 6- by 5-foot (1,452 trees per acre) or a 6- by 6-foot (1,210 trees per acre) spacing.
    c. square or diamond spacings should be established if mowing is to be done in both directions.
4. Direction of rows:
    a. is determined by the shape or topography of the field.
    b. usually follows the contour, which permits easier mowing.

INFORMATION SHEET #5

Selecting Planting Stock

1. Successful Christmas tree production begins with quality seedlings.

2. Good seedlings have a well-developed fibrous root system, a sturdy stem, and a balance between the top and the root system.

3. Seedlings should be neither too tall or too short: 6 - 10 inches is about right.

4. Planting stock can be purchased from either state or commercial nurseries.

5. Contact the Cooperative Extension Service in your county for information about obtaining trees from the state nurseries.

INFORMATION SHEET #6

Planting Seedlings

1. The best time to plant seedlings is in the spring before tree growth has started.

2. When seedlings are received, the roots should be wetted and the bundle stored in a shaded, cool place, out of the wind, where freezing can be prevented.

3. During planting, keep the seedlings in a bucket with the roots covered with water.

4. Three methods of planting seedlings are:

   a. the planting bar (one individual, 500 seedlings per day).

   b. the hole method.

   c. the tree planting machine (6,000 - 8,000 seedlings per day).

5. Regardless of method used:

   a. plant seedlings at about the same depth.

   b. plant seedlings so that their main roots are straight down, not doubled or sharply bent.

6. Fertilization is typically not required for pines, which have low fertility requirements.

7. Survival rate of planted seedlings is determined in the fall and spring following the first growing season in the field.

INFORMATION SHEET #7

Seedling Protection

Once seedlings are planted, the task of growing Christmas trees depends upon several protective measures.

1. Fire — Fire can completely destroy a Christmas tree planting. Because no location is completely safe from fire, fire precautions should always be taken. The grower should have fire tools available and be ready to suppress any fire.

2. Animals — Animals stunt and deform trees by trampling, browsing, and brushing against them. Animals also compact soil, causing slower growth and deformed trees. A fence constructed around plantations helps prevent domestic animals from entering, but does not restrict wild animals. Control of heavy grass and weed growth, and the use of poison bait usually reduce mice and gopher populations. Hunting and trapping can reduce deer, rabbit, and groundhog damage.

3. Weeds — Grass and weed competition may be controlled by mowing and chemicals. Availability of labor and topography of the area might dictate the use of chemicals for weed control.

4. Insects — Prompt identification and control of destructive insects is a must for producing Christmas trees. Even minor foliage damage by insects demands corrective action. There is no need to follow a specified spray schedule, simply use a spray treatment only when needed.

5. Diseases — Diseases of Christmas trees may be classified as either infectious or noninfectious. The infectious diseases are transmitted from one tree to another, whereas the noninfectious are not.

INFORMATION SHEET #8

Cultural Practices

1. Shaping — Shaping is the most important cultural practice in producing salable trees. Shaping can be divided into shearing and pruning.

   a. Shearing refers to the light clipping of limbs near their ends to achieve a conical shape with correct taper and desirable density.

   b. Pruning refers to the removal of multiple terminals and double stems and cutting the terminal at the correct angle to insure a single vertical stem.

   A properly shaped Christmas tree should have:

   a. A single straight stem.

   b. A similar shape when viewed from all directions.

   c. Foliage that is compact (no large openings) but not too dense.

   d. The correct taper.

   e. An eight-inch handle at the base of the tree.

2. Pruning — In pruning pine, you should cut the main leader to the desired length, usually 10 to 14 inches. This cut should be made at an angle of approximately 45 degrees or more to the axis of the tree. After the cut is made on the main leader, clip lateral limbs of the uppermost whorl of limbs approximately four to five inches shorter than the terminal. Next, proceed around and downward on the tree to achieve the desired cone shape. A minimum of shearing should be done during the season immediately preceding harvest so that the trees will have a natural appearance.

3. Tree color — Trees may be sprayed in the field with green colorant in early fall to mask the natural yellowing that occurs on some trees. The colorants are dyes that do not harm the living tree. Some consumers may object to the artificial color, but most demand it.

4. Fertilizing — The soil should be tested by a reliable soil-testing laboratory for the standard nutrients and pH. By applying different rates of fertilizers to a few trees a year, you should be able to determine whether fertilization of your plantations would be worthwhile.

5. Stump Culture — Growers who operate their plantations on an all-age rotation sometimes leave a branch attached to the stump that remains after the tree has been harvested. This branch will become the main stem of a new Christmas tree.

INFORMATION SHEET #9

Harvesting Christmas Trees

1. Time of harvest depends on:
    a. the market being supplied.
    b. the species grown.
    c. the rate of tree growth.
    d. weather.
2. Most trees marketed in Illinois range from five to seven feet in height.
3. To produce an average size (five to seven foot) Scotch pine, about eight years are required.
4. Trees to be cut are tagged during early fall.
5. At present, no uniform method is used to mark or tag Christmas trees.

INFORMATION SHEET #10

Marketing Christmas Trees

1. Outlets for Christmas trees come under two broad categories:
    a. Wholesale — A volume operation, a simpler market arrangement with less risk and lower price. For a wholesale market, you would have a minimum of 40 acres in trees.
    b. Retail — In retail sales you can sell the trees in the plantation, in a retail lot adjacent to the plantation, or in a lot in a nearby town.
2. The retail salesperson should be someone who can meet with customers and has two to three weeks available during the sales season.
3. Selling in the plantation (choose and cut) has both advantages and disadvantages.
    a. Advantages:
        - low overhead
        - only those trees selected by the buyer are cut
        - there are no transportation costs
        - seller usually makes a larger profit per tree
    b. Disadvantages:
        - requires a location on an all-weather road
        - no facilities for sales during bad weather
4. Advertising practices include the following:
    a. Successful Christmas tree growers advertise on radio and television, in newspapers, on road signs, and through direct contacts.
    b. By selling only compact premium-quality trees that have been freshly cut and symmetrically shaped, growers ensure that customers will return in following years.

INFORMATION SHEET #11

Costs and Returns

Costs can be divided into two types: fixed and variable.

1. Fixed costs
   a. Land values usually remain the same.
   b. Annual taxes could increase after seedlings have been planted.
   c. Equipment will depend on size and quantity needed.
2. Variable costs
   a. herbicide.
   b. pesticide.
   c. advertising.
   d. seedlings.
   e. labor.

Returns can be divided into two types: monetary and intangible.

1. Intangible — Benefits include wildlife habitat and conserving soil.
2. Monetary — Dollars received through sales of trees.

Growing Christmas trees is a business that demands good management. Keeping accurate records is especially important: they are your reference for tax purposes, and they often indicate that certain management practices need to be changed. Growers are constantly faced with sales, income, capital gains, and a host of other taxes. Advice on taxes and on both oral and written contracts can be obtained from a competent individual or firm.

INFORMATION SHEET #12

Illinois Christmas Tree Farms

Amboy

Floyd Welch Farm
Owner/Operator: Floyd Welch
Rt. 1, Sublette, IL 61367
(815) 376-7022

Take Amboy blacktop to Morgan road. Turn left or south on Morgan road and go to the end of Morgan road. Last place.

Andover

Polaris Tree Farm
Owner/Operator: Paul L. Olson
Rt. 1, Box 52, Cambridge, IL 61238
(309) 476-8494

1 ¾ mile south of tavern at Andover and ½ mile east.

Antioch

Hayden's Christmas Tree Farm
Owner/Operator: William Hayden
42880 Hunt Club Rd., Antioch, IL 60002
(312) 395-4127

I-94 north to IL 173, exit west ½ mile to Hunt Club Road, north 1 $^1/_3$ mile.

Augusta

Herb Chockley's Tree Farm
Owner/Operator: Herb Chockley
1836 N. Williams Creek Rd., Augusta, IL 62311
(217) 392-2315

Cut your own or buy at the house.

Beardstown

Illinois Forest Products
Owner/Operator: Glen Massie - I.F.P.
Rt. 1, Box 194, Beardstown, IL 62618
(217) 323-4540

¼ mile south on Arenzville Rd. Large A-frame building on west side of highway.

Beardstown

Owner/Operator: Melvin Rawlins
1020 Washington St., Beardstown, IL 62618
(217) 323-3672 or 323-2712

4 miles east of Beardstown on Chandlerville road (Lincoln Memorial Highway).

Beason

Randolph Woods
Owner/Operator: Harry M. Randolph
Kenney, IL 61749
(217) 447-3519

4 ½ miles southeast of Beason.

Bethalto

Town and Country Lakes
Owner/Operator: Harold and Melvin Balsters
Rt. 1, Box 7, Bethalto, IL 62010
(618) 377-9645 or 377-9745

Route 140 - Meadowbrook. Turn right on Neunaber St. 1 mile. Open three weekends before Christmas — Saturday and Sunday 10 a.m. till dark.

Bolingbrook/Romeoville/Lemont

Hassert Tree Farm
Owner/Operator
Rt. 2, Joliet Rd., Lemont, IL 60439
(312) 739-7951

1 mile south of I-55 on Joliet Road Exit — if coming from Old Chicago or N. suburbs south 1 mile north of 53 on Joliet Road.

Scotch Pine 5 to 7 feet.

Bonfield

Rabideau's Christmas Trees
Owner/Operator: Arlyn and Jackie Rabideau
Rt. 1, Box 44, Clifton, IL 60927
(815) 694-2113

13 miles west of Kankakee on Rt. 17 to road number 1300W. 3 ½ miles north.

Buffalo

Morris-Siemert Tree Farm
Owner/Operator: Matt Siemert, Managing Partner
304 S. East, Cambridge, IL 61238
(309) 937-2038

Exit 13 off I-72 south to watertower then 1 mile west.

Butler

Abacus Tree Farm
Owner/Operator: John S. Sester
Box 217, Butler, IL 62015
(217) 532-3518

½ mile west on road at north edge of Butler.

Camp Point

Searls
Owner/Operator: Dean Searls
Camp Point, IL 62320
(217) 593-6389

At farm located 1 ½ miles north of Junction of U.S. Hwy. 24 and State Rt. 94.

Carbondale

Southern Illinois Airport
Owner/Operator:
Southern Illinois Airport Authority
P.O. Box 1085, Carbondale, IL 62901
(618) 529-1721

Two miles north of Highway 13. Inquire at Airport Manager's Office.

Cisne

M & M Tree Farm
Owner/Operator: Michael Janes
Rt. 3, Cisne, IL 62823
(618) 673-2794

2 miles east of Cisne on Rt. 45 to Intersection of Mt. Erie blacktop (marked by flashing caution light) then north on oil road for 1 mile then east on gravel road for ½ mile.

Clinton

Fry's Christmas Trees
Owner/Operator: Clyde E. Fry
617 N. Mulberry, Clinton, IL 61727
(217) 935-3883

½ mile west from Rt. 51 on Webster St. (North part of Clinton). Open Saturday and Sunday p.m. other times at 617 N. Mulberry.

Decatur/Mt. Zion

4 E's Trees, Inc.
Owner/Operator: Frank Evans
Rt. 6, Box 98, Decatur, IL 62521
(217) 864-4704

½ mile west and ½ mile south of Mt. Zion.

Downers Grove

Ide Tree Farm
Owner/Operator: Charles Ide
1500 83rd St., Downers Grove, IL 60515
(312) 968-5786

Take I-55 to Lemont Road. Exit north to second traffic light. Turn left or west till you see signs on right.

Hours: 9:30 a.m. to 4:00 p.m. Closed Mondays and Tuesdays.

Downers Grove

La Rue Christmas Tree Farm
340 Oldfield Rd. (87th St.), Downers Grove, IL 60515
(312) 985-7890

I-55 to Cass Ave. North. Immediately turn left (west) on frontage road, 1 ½ miles to Oldfield Road, turn right. First house on left.

Dundas

Kermicle Farms
Owner/Operator: Gerald Kermicle
Rt. 1, Dundas, IL 62425
(618) 754-3570

3 ½ miles southwest of Dundas.

Essex

Tammen Treeberry Farm
Owner/Operator: Lorenz Tammen
Rt. 2, Box 1C, Kankakee, IL 60901
(815) 939-4060

1 mile east of Braidwood on Route 113, then 3 ½ miles south on Essex blacktop.

Eureka

Glenn Sparks Pines
Owner/Operator: Glenn Sparks
Box 273, Eureka, IL 61530
(309) 467-3464

5 miles southest of Eureka, or 5 miles north and 1 mile west of Congerville.

Forest City

Heinhorst Tree Farm
Owner/Operator: Ralph and Albertz Heinhorst
Rt., Forest City, IL 61532
(309) 562-7343 or 562-7363

4 miles west of Jcts. Rt. 29 and U.S. 136.

Fulton

Neumann's Singing Pines
Owner/Operator: Ellis S. Neumann
Rt. 1, Box 267, Fulton, IL 61252
(309) 887-4933

Off U.S. 30 south ¼ mile on Chase Road, which is first crossroad east of Illinois Rt. 84.

Geneseo

Christmas Forest
Owner/Operator: Eldon and Muriel Weber
Rt. 1, Geneseo, IL 61254
(309) 944-4991

Located 4 ½ miles east of Junction Rt. 82 and 92. North of Geneseo.

Goreville

Jenkins Christmas Tree Farm
Owner/Operator: J. W. Jenkins
Rt. 1, Goreville, IL 62939
(618) 994-2426

Off I-57, 3 miles east of Exit 40 or ½ mile west of Goreville State Bank on blacktop.

350

Grayslake
Century Tree Farm
Owner/Operator: S. P. Osgood
1600 Gages Lake Road, Grayslake, IL 60030
(312) 362-7571
1 mile north of Rt. 120 on U.S. 45 to Gages Lake Rd. East 1 mile to farm.
Scotch, Red, and White Pine

Green Valley
Talbott's Christmas Trees
Owner/Operator: Robert Talbott
Rt. 2, Manito, IL 61546
(309) 545-2278
6 ½ miles south of Pekin on Route 29.

Greenup
Pine Lake Christmas Trees
Owner/Operator: Herbert Vanatta
Rt. 2, Box 168, Greenup, IL 62428
(217) 923-3640 or 923-3695
Go south of Greenup on Rt. 130 to Liberty Hill. Go west 1 ½ miles, go south 1 ¼ miles, go west ½ mile, and turn south, go ¼ mile.

Greenville
Daniken Tree Farm
Owner/Operator: Maurice and Betty Daniken
Rt. 3, Greenville, IL 62246
(618) 664-2685
5 miles west of Greenville on Rt. 140.

Harrisburg
Owner/Operator: Leo DeNeal
Rt. 3, Harrisburg, IL 62946
(618) 252-6631
10 miles southeast of Harrisburg on Rt. 34 (near Rudement).

Highland
Plocher Christmas Tree Farm
Owner/Operator: Darrell Plocher
Rt. 1, Highland, IL 62249
(618) 887-4413
3 miles west of Highland (on Hwy. 143), first road past Silver Lake make right turn; 2 miles turn left ("T" in the road); 1 ½ miles on left side. There are signs on the weekends from Thanksgiving on.

Illiopolis/Mt. Auburn
Owner/Operator: Joe Donovan
Illiopolis, IL 62539
(217) 486-3767
3 - 4 miles southwest Illipolis on Mt. Auburn Road (from Mechanicsburg blacktop) or 3 miles north of Mt. Auburn on same road.

Lake Villa
Gengel Tree Farm
Owner/Operator: Ron Gengel
410 N. Fairfield, Lake Villa, IL 60046
(312) 356-5661
West of Lake Villa on Fairfield Road half mile north of Grand Ave. (132) second farm on left.

Lakewood
Wakefield's Tree Farm
Owner/Operator: Paul Wakefield
Rt. 1, Lakewood, IL 62438
(217) 783-2401
Two miles south and ¾ mile east of Lakewood.

La Salle
Coon's Grove Plantation
Owner/Operator: H. D. Conkey and Company
P.O. Box 160, Mendota, IL 61342
(815) 539-5621
Rt. 51 north to 35th Road, east on 35th Road approximately 2 miles. Entrance on north side just as you pass over Little Vermilion River Bridge.

Latham/Mt. Pulaski (Logan County)
Garrison Brothers Trees
Owner/Operator: Larry and Verne Garrison
Rt. 1, Mt. Pulaski, IL 62548
(217) 674-3476 (Farm) 732-9661 (Office)
3 miles south of Cob Plant (on U.S. 121) then 1 ½ miles east.

Manlius/Sheffield
Osage Ranch
Owner/Operator: Kenneth Rodgers
Rt. 2, Sheffield, IL 61361
(309) 454-2532
8 ½ miles north of Sheffield Jct. 6 and 34 or 6 miles west of Manlius.

Melvin
Pool's Pine Acres
Owner/Operator: John W. Pool
Melvin, IL 60952
(217) 388-2415
½ mile south of Melvin. 3 ½ acres to choose from Scotch and Red Pines.

Millstadt
Reindeer Forest
Owner/Operator: B. W. Brink
109 N. Main St., Caseyville, IL 62232
Located approximately 2 miles northwest of Concordia Church, off Hwy. 163. Turn off Hwy. 163 onto Forest Hill Road. Go west to Eckert Orchard. Plantation is just north of Orchard.

Monticello
Tipsword Tree Farm
Owner/Operator: Joe Tipsword
Rt. 2, Monticello, IL 61856
(217) 762-7933

1 mile west and ½ mile south of Monticello on the County Farm Road.

Muncie
Jake Ludwig Farm
Owner/Operator: J. V. "Jake" Ludwig
Rt. 2, Fithian, IL 61844
(217) 776-2721

6 miles north Muncie or 3 miles north Oakwood then 3 miles west then 2 miles north.

Neoga
Tom Helm Farm
Owner/Operator: Tom Helm and family
Rt. 1, Neoga, IL 62447
(217) 895-2400

½ mile southwest of Trowbridge.

North Aurora
Marmion Abbey Farms
Owner/Operator: Marmion Abbey
Butterfield Road, Aurora, IL 60504
(312) 897-7215

On Butterfield Road (56), 1 mile east of North Aurora, four miles west of Junction 59 and 56. From Tollway (5) take north exit at Farsworth to Butterfield (56), west (left) on Butterfield for ¼ mile.

Oakdale
Alfeldt Bros. Farm
Owner/Operator: Cecil D. and Rudy V. Alfeldt
Rt. 1, Oakdale, IL 62268
329-5256

3 miles northwest of Oakdale.

Oakland
Curtis Tree Farm
Owner/Operator: Mike and Harold Curtis
Box 173, Charleston, IL 61920
(217) 345-7370

First road west of Oakland on Rt. 133. Go south 6 miles. Directional signs are erected in October of each year.

Oblong
Owner/Operator: C. E. Lindley
206 W. Illinois, Oblong, IL 62449
(618) 592-3222

2 miles east of Oblong on Route 33. (Lindley Animal Hospital)

Olney
Heindselman Christmas Tree Farm
Owner/Operator: Alan, Virgil, and Jim Heindselman
Rt. 5, Olney, IL 62450
(618) 395-2934

West on Rt. 50 to Pleasant Valley Church of Christ, turn north for 100 yds. then west 400 yds. (Just follow the signs.)

Paloma
Morton Tree Farm
Owner/Operator: Gerald Morton
Rt. 1, Coatsburg, IL 62325
(217) 936-2415

2 miles north of Paloma; follow tree signs.

Pekin/Manito
Dodson Christmas Tree Farm
Owner/Operator: Donald and Ellen Dodson
Rt. 2, Manito, IL 61546
(309) 545-2153

From Pekin, take Rt. 29 to Manito Rd., follow it to the Sky Ranch Restaurant. Turn right and go 1 mile.Turn left at top of hill. From Manito, go north on Manito blacktop to Sky Ranch Restaurant. Turn left and go 1 mile, turn left at top of hill. Note: Customers can drive through tree fields.

Pittsfield
Pittsfield High School
Owner/Operator: Pittsfield FFA Chapter
Pittsfield, IL 62363
(217) 285-6888

At high school.

Port Byron
Owner/Operator: John and Twila Searl
22716 45th Ave. North, Port Byron, IL 61275
(309) 523-2410

Exit 16 off Rt. 5 to 221st or Port Byron Road, first right, the first house on right.

Prophetstown/Erie
Sherwood Forest
Owner/Operator: Lin and Carol Proeger
Rt. 1, Box 151, Prophetstown, IL 61277
(815) 537-2597

5 miles southwest of Prophetstown on Springhill blacktop or 5 miles southeast of Erie. Watch for signs.

Ramsey
The Dean Hills
Owner/Operator: Don Ferral
Rt. 2, Ramsey, IL 62080
(618) 423-2357

8 miles east of Ramsey on the Herrick blacktop.

Rio

McCaw Tree Farm
Owner/Operator: Forrest McCaw
Rt. 1, Rio, IL 61472
(309) 872-3671
1 mile north of Rio corner on U.S. Rt. 150.

Rock Falls

Nelson's Tree Farm
Owner/Operator: Jerry and Ev Nelson
5619 Murphy Rd., Rock Falls, IL 61071
(815) 626-0304

Approximately 8 miles south of Rock Falls on IL 88; turn east on Bell Road 1 ½ miles.

Rockton

Blackhawk Tree Farm
Owner/Operator: Mr. and Mrs. C. B. Dahl
3459 Yale Bridge Rd., Rockton, IL 61072
(815) 624-2098
2 ½ miles northwest of Rockton.

Springfield

Pine Acres
Owner/Operator: Melvin E. Barth
2700 Arrowhead Dr., Springfield, IL 62702
(217) 789-4752

Tilden

Vanek Christmas Tree Farm
Owner/Operator: Ronald and Charlotte Vanek
Rt. 2, Coulterville, IL 62237
(618) 587-5151

Approximately 30 miles southeast of Belleville, IL; Follow IL Rt. 13 from Belleville to Tilden. Turn north at post office. Follow signs.

Tower Hill

Winings Tree Farm
Owner/Operator: Lawrence and Marie Winings
Rt. 1, Tower Hill, IL 62571
(217) 567-3346

5 miles south of Tower Hill on Herrick Road then west to first road south, south to first road west, west to first house on north side.

Open for pre-selection month of November only. Weekends only, or by appointment. No selection after November 30. Pre-selected trees may be cut anytime after selection.

Trivoli

Grady Christmas Tree Farm
Owner/Operator: Robert Grady
Rt. 1, Box 120, Trivoli, IL 61569
(309) 568-2204

On Route 116, 2 miles west of Trivoli, south on Stone School Road 4 ½ miles.

Viola

Schillinger's Tree Farm
Owner/Operator: John F. Schillinger
Rt. 1, Viola, IL 61486
(309) 596-2463

From Rt. 67 in Viola turn east at post office ½ mile to tree farm sign, then north 1 mile.

Watseka

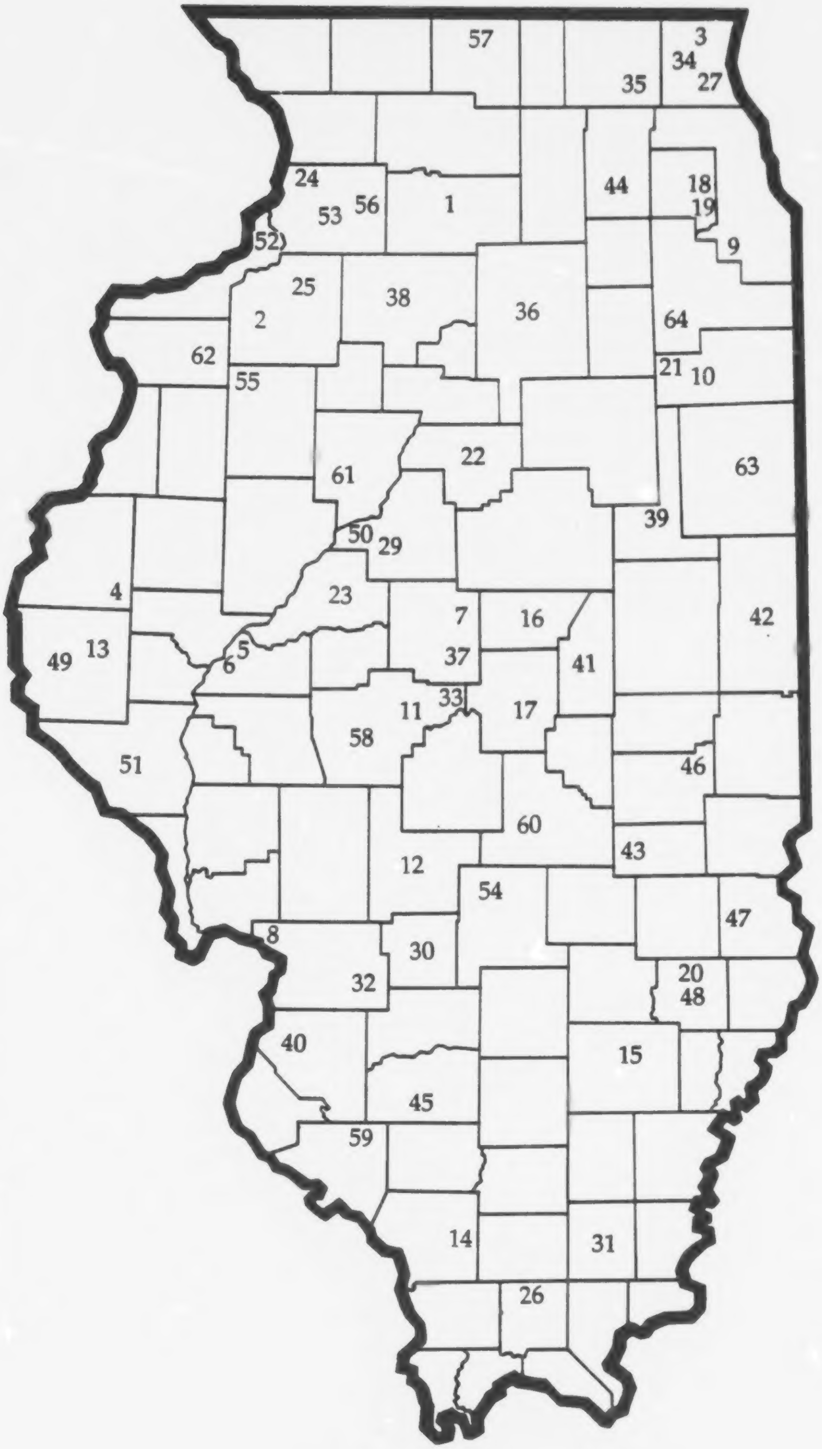
Coaler Farm
Owner/Operator: John W. Duff, Kenneth Tucker
Watseka, IL 60970
(815) 432-2528
1 mile south of Watseka, east of Woodland Road.

Wilmington

Whispering Sands
Owner/Operator: George and Marilyn Benes
228 Hintze Rd., Wilmington, IL 60481
(815) 476-9275

From Wilmington (Rt. 53 and Rt. 102) take 102 3 miles to oil storage tanks. First right at end of fence ¾ miles on gravel road. Signs are out.

T. W. Curtin
10/22/80


57
3
34
27
35
44
18
19
9
24
53
56
1
52
25
38
36
2
64
62
21
10
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61
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42
4
7
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6
49
13
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41
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51
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60
43
12
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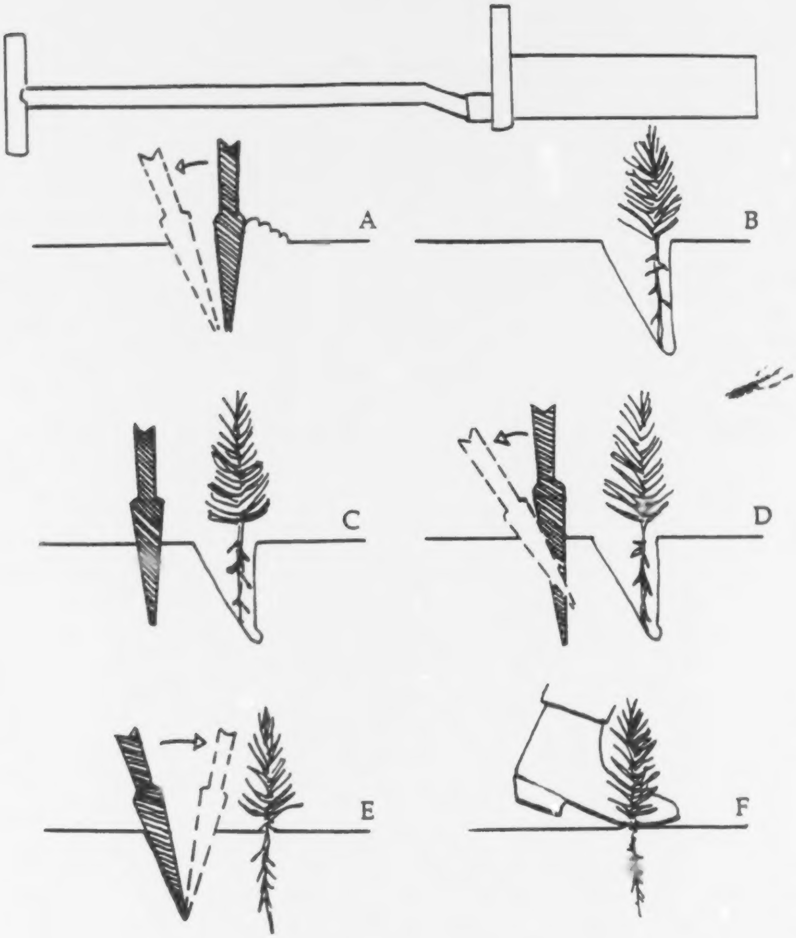
31
26

TRANSPARENCY MASTER #1

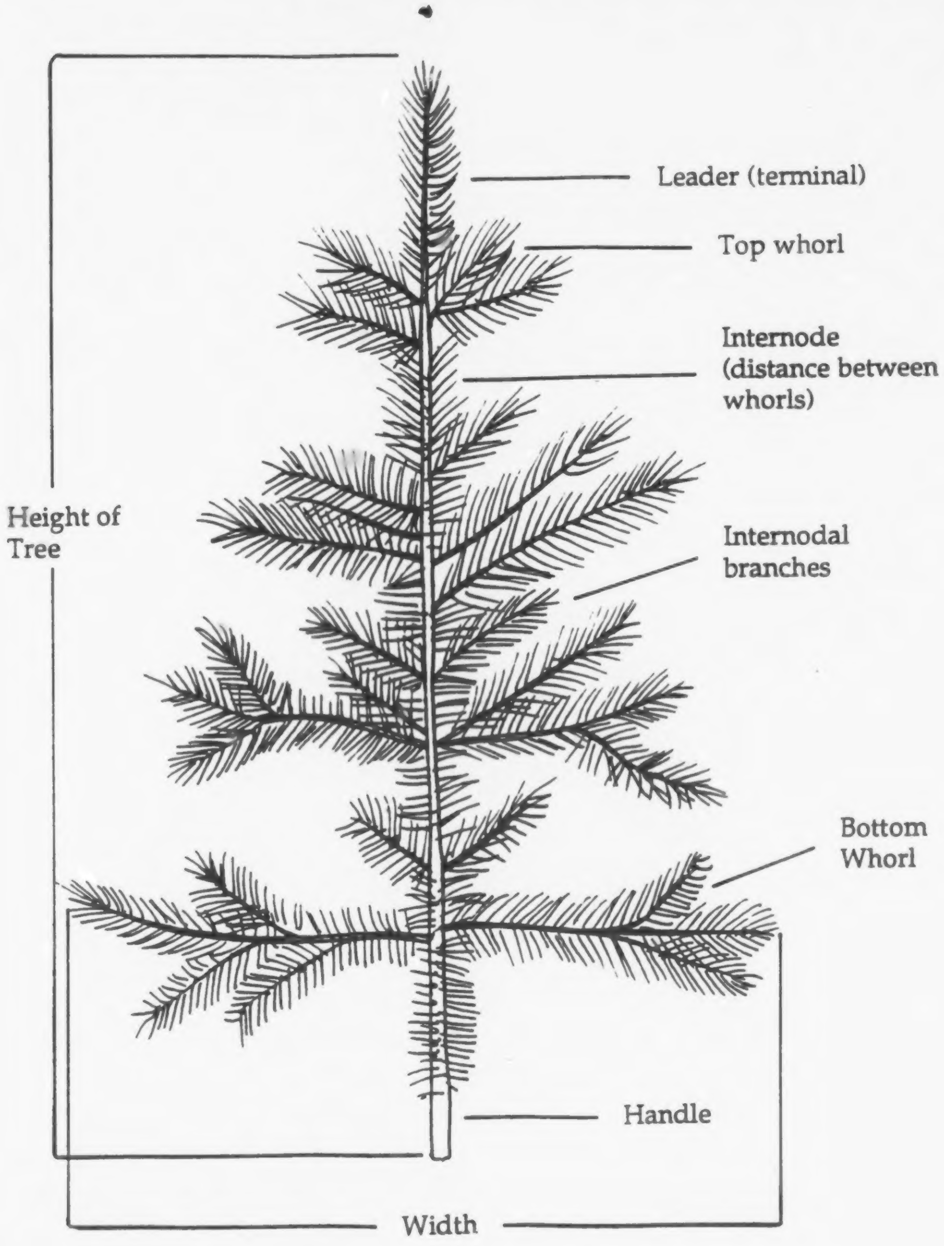
Planting Seedlings



Planting seedlings with a planting bar: A. Insert the planting bar as shown and pull it towards you; B. Remove the planting bar and place the seedling at the correct depth; C. Insert the planting bar two inches away from the seedling; D. Pull the handle of the planting bar towards you, firming the soil at the bottom of the roots; E. Push the handle of the planting bar away from you, firming the soil at the top of the roots; F. Firm the soil around the seedling with your feet.

TRANSPARENCY MASTER #2

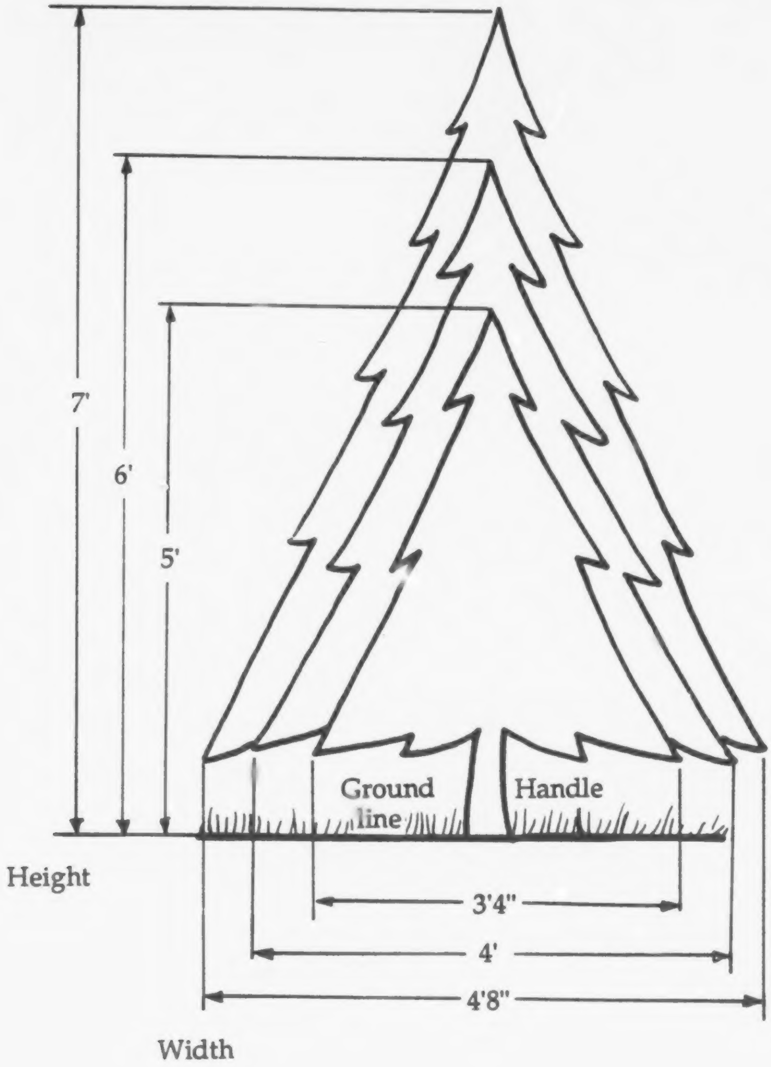
Common Terms for Christmas Tree Parts


Leader (terminal)
Top whorl
Internode (distance between whorls)
Height of Tree
Internodal branches
Bottom Whorl
Handle
Width

TRANSPARENCY MASTER #3

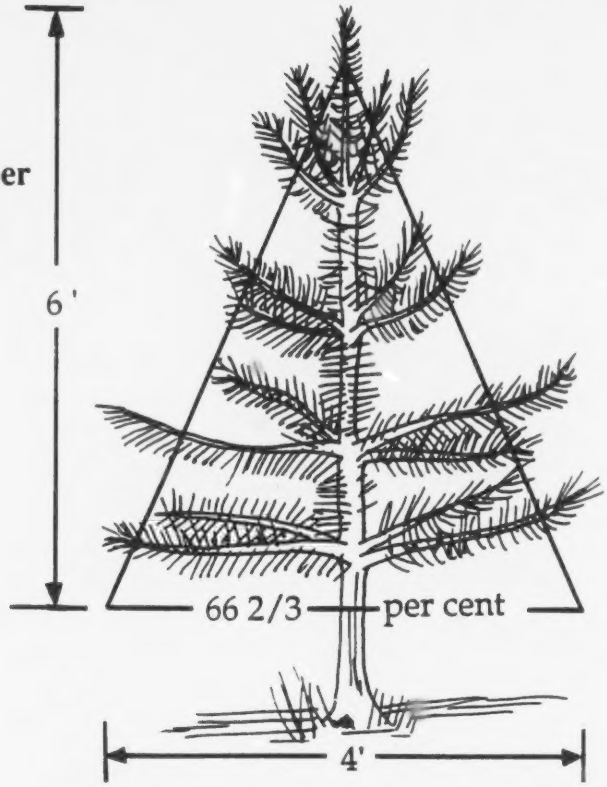
Desirable Tapers

Desirable tapers for five, six, and seven foot trees with the width two-thirds the height


7'
6'
5'
Ground line
Handle
Height
3'4"
4'
4'8"
Width

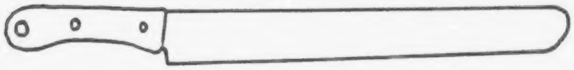
TRANSPARENCY MASTER #4

Christmas Tree Shaping

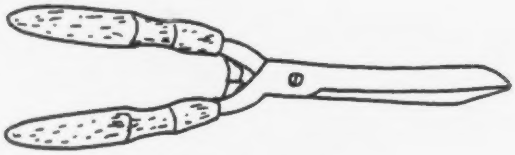


Try to maintain
60 - 70 percent taper

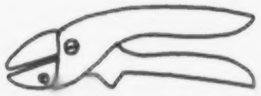
Shearing and Pruning Tools



Shearing Knife



Hedge Shears

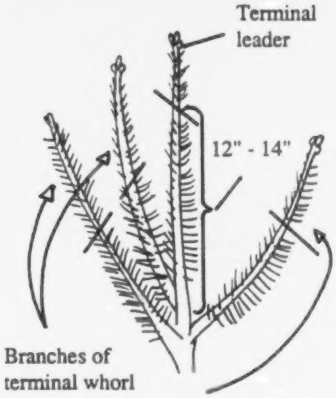


Anvil Pruners

TRANSPARENCY MASTER #5

Shearing Christmas Trees

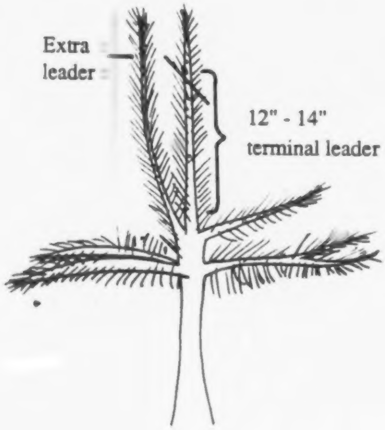
Controlling Height


Terminal leader
12" - 14"
Branches of terminal whorl

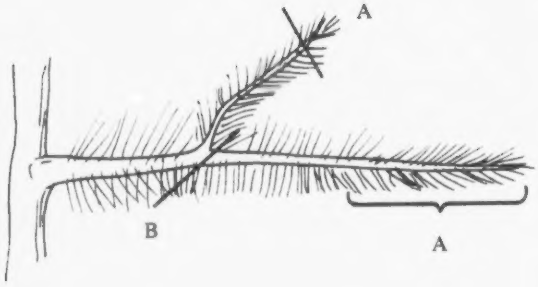
Cut terminal leader to 12" - 14". Cut branches of terminal whorl to about ½ length of leader.

Eliminate Extra Leaders

Eliminate extra leaders while trees are young


Extra leader
12" - 14" terminal leader

Developing Uniform Taper and Density



Confine shearing primarily to new growth (A). If necessary to go back into old growth, cut at junction of side limb (B).

TRANSPARENCY MASTER #6

Costs for Planting Through Harvesting (1983 dollars)

Item (Pct. survival)		Cost per acre
Planting stock (100%)	1,307 trees @ $.12/tree	$ 157
Planting cost (100%)	1,307 trees @ $.12/tree	157
Shearing costs (yr. 3 - 7) (90%)	$.08/tree/year, 5 years	470
Colorant spray (70%)	$.25/tree	229
Harvesting (70%)	$.10/tree	91
Grass and weed control chemicals (yr. 1 - 3)		60
Mowing (yr. 1 - 7)	$20/acre/year, 7 years	140
Insect and disease control	$10/acre/year, 7 years	70
Repair and maintenance		55
Hand tools and miscellaneous		130
Land cleanup		50
Advertising		50
Total		$1,659

Returns From Trees Harvested (1983 dollars)

No. of yrs. after planting	Pct. harvested (Out of 70% survived)	Income per acre
5	10% (82 trees @ $11.50 each)	$ 943
6	30% (247 trees @ $12.00 each)	2,964
7	40% (329 trees @ $13.00 each)	4,277
8	20% (165 trees @ $12.50 each)	2,062
Total		$10,246

Estimate of the returns an average grower should expect for Scotch pine, planted at a 5- by 6-foot spacing (1307 trees per acre, because 10% of each acre is in lanes and roads) over an eight-year period.

Shearing cost figured on a 90% survival rate, colorant spray and harvesting on a 70% survival rate.

STUDENT ACTIVITIES

STUDENT WORKSHEET #1 — Christmas Tree Production

For additional activities, teachers may refer to the "Suggested Teaching Activities and Procedures" section in the Instructor's Guide.

STUDENT WORKSHEET #1

Christmas Tree Production

1. What seven things must you take into consideration before growing Christmas trees?

2. What are two busy times of the year when growing Christmas trees?

3. List the three methods for marketing Christmas trees and briefly describe each method.

4. List two Christmas tree species and an advantage of each.

5. What is the number one hazard to Christmas trees and how is it prevented?

6. List three means of controlling vegetation competing with Christmas trees.

7. If you wished to shape an ideal tree which was nine feet tall, the base would be how many feet wide?

8. List the four objectives of shaping a Christmas tree.

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Forestry

PROBLEM AREA: Processing Forestry Products

RELATED PROBLEM AREAS:

1. Conserving Water Resources
2. Classifying Trees
3. Producing Christmas Trees
4. Maintaining Wildlife Habitat
5. Managing Game Preserves
6. Managing Hunting and Fishing Clubs
7. Managing Parks and Recreational Areas

PREREQUISITE PROBLEM AREA(S):

1. Identifying Trees and Forestry Products
2. Managing Forestry Resources

LEVEL: Preparatory

OCCUPATIONAL TASKS ADDRESSED:

Agricultural Resources Cluster

Duty A: Managing the Recreational Facility

1. Determine land-use capability
2. Assist in development of resource conservation plans

Duty B: Applying Laws, Regulations and Policies

1. Interpret game and wildlife laws
2. Interpret stream, lake, pond and groundwater laws

Duty D: Managing Facility Flora and Fauna

1. Identify plant communities and dominant species within a selected area
2. Identify native plant species within a selected area

Duty G: Assembling, Servicing and Maintaining Equipment and Facilities

1. Follow a facility and grounds maintenance schedule
2. Report facility and grounds maintenance needs
3. Perform preventative and scheduled maintenance activities on grounds and facilities

Duty H: Applying Safety Practices

1. Implement plans to protect animals and plants and other resources from visitors

STATE GOALS FOR LEARNING

In planning the instruction for this problem area, teachers can promote the development of several student learning objectives which are related to the State Goals for Learning in Biological and Physical Sciences. These objectives are listed on the Learning Assessment Plan forms included on the following page(s). Those learning objectives marked with an asterisk (*) are taken from the sample lists provided by the Illinois State Board of Education.

CORE
Illinois Agricultural Core Curriculum
Agricultural Education 124 Mumford Hall 1301 W. Gregory Drive University of Illinois Urbana, IL 61801

Director: Dale A. Law, Ed.D.
Principal Investigator: Jerry D. Pepple, Ed.D
Research Assistant: Kevin J. Enderlin

Illinois Agricultural Core Curriculum Rev.

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

Submission Date__________

☐ **Original submission** ☐ **Revision**

Page ____ of ____

I. LEARNING AREA *(check one)*

☐ Language Arts
☐ Mathematics
☐ Sciences
☐ Fine Arts
☒ Social Sciences
☐ Physical Development/Health

(Affix label or complete district information.)

COUNTY	DISTRICT	ESC

District Name

City

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will be able to apply the skills and knowledge gained in the social sciences to decision making in life situations.

Contact Person: __________

Title: __________

Phone: ( )

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Compare the economic interdependence among agriculture, business, government, labor and the consumer.					
*2. Understand the relationships between educational attainment and entry into varied occupational fields.					
*3. Understand the knowledge and skills required for success in selected fields of work.					
4. List the specifications of logs used for pulp-wood, fence posts, mine timbers, railroad cross ties, saw timber, poles, pilings, and veneer timber.					
5. Identify the steps in processing saw timber in a sawmill.					
6. Discuss the advantages and disadvantages of coal-tar creosote wood preservative.					

Processing Forestry Products

Agricultural Resources
Forestry

ISBE 41-78 (1/88)

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

Submission Date____________________
☐ **Original submission** ☐ **Revision**
Page ____ of ____

I. LEARNING AREA *(check one)*
☐ Language Arts ☐ Fine Arts
☐ Mathematics ☐ Social Sciences
☒ Sciences ☐ Physical Development/Health

(Affix label or complete district information.)
COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐
District Name
City

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will have a working knowledge of the social and environmental implications and limitations of technological development.

Contact Person: ____________________
Title: ____________________
Phone: (   )

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Evaluate the ways in which natural resources have been allocated, utilized and conserved in the nation.					
2. Identify products derived from commercial tree species.					

ISBE 41-78 (1/88)

Processing Forestry Products

4

Illinois Agricultural Core Curriculum Rev.

Agricultural Resources
Forestry

ILLINOIS STATE BOARD OF EDUCATION
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(Affix label or complete district information.)

COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐

District Name

City

I. LEARNING AREA *(check one)*

☐ Language Arts
☐ Mathematics
☒ Sciences
☐ Fine Arts
☐ Social Sciences
☐ Physical Development/Health

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will have a working knowledge of the concepts and basic vocabulary of biological, physical and environmental sciences and their application to life and work in contemporary technological society.

Contact Person: ____________________
Title: ____________________
Phone: (   )

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Give examples of change in matter and decide if they are physical or chemical in nature.					
*2. Compare living organisms by applying a classification scheme.					
3. Provide a definition of wood.					
4. Discuss the chemical and physical properties of wood and how they affect its use as a particular wood product.					
5. List the qualities of a good wood preservative.					

ISBE 41-78 (1/88)

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Forestry

PROBLEM AREA: Processing Forestry Products

STUDENT LEARNING OBJECTIVES

Upon completion of their study of this problem area, students will be able to:

1. Provide a definition of wood.
2. Discuss the chemical and physical properties of wood and how they affect its use as a particular wood product.
3. Correctly figure the weight of various wood species from their specific gravities.
4. Identify products derived from commercial tree species.
5. List the specifications of logs used for pulpwood, fence posts, mine timbers, railroad cross ties, saw timber, poles, pilings, and veneer timber.
6. Discuss the process of papermaking.
7. Identify the types of paper produced in a pulp paper mill.
8. Identify the steps in processing saw timber in a sawmill.
9. Identify the regions of the United States that possess the greatest decay hazard potential to wood.
10. Discuss how wood is prepared for preservation treatment.
11. List the qualities of a good wood preservative.
12. Discuss the advantages and disadvantages of coal-tar creosote wood preservative.
13. Discuss the heat value of wood as compared to coal or fuel oil.
14. Develop a plan for a firewood enterprise.
15. Identify how to tap maple trees, collect maple sap, and boil maple sap into syrup.
16. Locate sawmills in the local area.

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Forestry

PROBLEM AREA: Processing Forestry Products

PROBLEMS AND QUESTIONS FOR STUDY **INSTRUCTOR'S NOTES AND REFERENCES**

1. What is wood?
2. What chemical and physical properties of wood would help in determining which product a type of wood is best suited for?
3. How is the weight of wood figured?
4. What forest products do we get from commercial trees?
5. Do logs used for different forestry products need to meet different specifications?
6. How is paper made from trees?
7. What are the types of paper products?
8. How are logs cut into boards?
9. What areas of the United States possess the greatest potential for decay of wood? Why?
10. How is wood prepared before being treated with preservative?
11. What qualities should a wood preservative possess?
12. What are the advantages and disadvantages of using coal-tar creosote as a wood preservative?
13. How does wood compare to coal and fuel oil as a source of heat?
14. How should one start a firewood enterprise?
15. Where do we get maple syrup?
16. How many sawmills are located within an hour drive of the school?

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Forestry

PROBLEM AREA: Processing Forestry Products

SUGGESTED TEACHING ACTIVITIES AND PROCEDURES

1. Identify a local sawmill from the Illinois sawmill directory. Contact the owner of the sawmill and make a class visit.
2. Have students try to make paper in class, following the same steps used by a paper mill.
3. Identify as many wood products as you can and have students bring samples of wood products to class.
4. Compare the weathering effects of untreated wood with treated wood.
5. Identify maple trees suitable for sap collection.
6. Plan a firewood business for one of the students in the class.
7. Refer to problem area *Identifying Trees and Forestry Products* for an information sheet on common forestry products.

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Forestry

PROBLEM AREA: Processing Forestry Products

REFERENCES

*1. *Forests and Forestry*. Holland, Rolfe, Anderson. Fourth Edition. Interstate Publishing, Inc., P.O. Box 50, Danville, IL 61834-0050. (217) 446-0500.

*2. *Timber Harvesting*. American Pulpwood Association. Interstate Publishers, Inc., P.O. Box 50, Danville, IL 61834-0050. (217)446-0500.

3. *Firewood for Fireplaces*. Cooperative Extension Service, 69C Mumford Hall, 1301 West Gregory Drive, Urbana, IL 61801.

4. *Making Maple Syrup*. Cooperative Extension Service, 69C Mumford Hall, 1301 West Gregory Drive, Urbana, IL 61801.

*Indicates highly recommended reference

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTIONAL RESOURCES

These resources are intended for use by teachers in planning and teaching the material for this problem area and may be adapted to fit the teaching method(s) used.

INFORMATION SHEET #1 — Definition of Wood

INFORMATION SHEET #2 — Wood Characteristics

INFORMATION SHEET #3 — Pulp and Paper Mill

INFORMATION SHEET #4 — Saw Milling Lumber and Panel Products

INFORMATION SHEET #5 — Wood Preservation

INFORMATION SHEET #6 — Preparing Timber for Preservative Treatment

INFORMATION SHEET #7 — Qualities of a Good Wood Preservative

INFORMATION SHEET #8 — Coal-Tar Creosote Preservative

INFORMATION SHEET #9 — Firewood as a Forestry Product

INFORMATION SHEET #10 — Collecting and Making Maple Syrup

INFORMATION SHEET #11 — Illinois Sawmill Directory

TRANSPARENCY MASTER #1 — Production of Paper

TRANSPARENCY MASTER #2 — Log Sawmill

TRANSPARENCY MASTER #3 — Specific Gravity of Selected Species

TRANSPARENCY MASTER #4 — Forest Products Derived from Commercial Tree Species

TRANSPARENCY MASTER #5 — Decay Hazard

TRANSPARENCY MASTER #6 — Maple Syrup Production

INFORMATION SHEET #1

Definition of Wood

Dictionary — hard, fibrous substance which makes up the greater part of stems and branches of trees.

Botanist — a complex plant tissue comprising the xylem part of vascular bundles and consisting mainly of parenchyma, fibers, tracheids, and vessels.

Chemist — product that is chiefly cellulose and lignin, with related materials.

Environmentalist — vascular tissue of trees which transports water with dissolved mineral salts, used as a major source of construction materials and as a fuel. Over-harvesting of trees for wood leads to reductions in soils, wildlife habitats, and O_2 generation.

Forester — an indispensable product of every person's everyday life.

INFORMATION SHEET #2

Wood Characteristics

Chemical Properties

Wood is made up of about 50 percent cellulose, 28 percent lignin, and small quantities of other materials. There is less lignin in hardwoods than in softwoods. Cellulose forms the framework of the cell wall and is the product used to manufacture paper. Lignin is the cementing material that binds the cells together and must be dissolved to separate the cells when making paper.

Physical Characteristics

Weight and strength — The weight of wood is usually expressed in terms of its specific gravity, or weight per cubic board foot. If the specific gravity of a wood is expressed as 0.56, it means that a given volume of wood weighs 0.56 times as much as an equal volume of water. Since a cubic foot of water weighs 62.5 pounds, a cubic foot of wood of the species with a specific gravity of 0.56 would weight 0.56 x 62.5 or 35 pounds.

Bending — For certain uses, such as in manufacturing furniture, it is necessary to bend wood. Some hardwoods are more readily softened by heat and moisture for this purpose than others. Elms, ashes, and pecan hickories are preferred where extreme bending is required. Oaks, birches, beeches, red gum, and maples are also used for bent parts where moderate bending is required. Southern pine can be used for minimum bends only. A variety of chemicals are used to aid in the bending of wood. Among them are urea, dimethylsulfoxide, and liquid ammonia.

INFORMATION SHEET #3

Pulp and Paper Mill

No two pulp and paper mills are alike because there are so many processes and variations. The principles are similar but the methods, quality, volume, and variety of products differ. The following are the stages of the paper milling process.

1. The process begins in woodlands, where trees designated as pulpwood are harvested and transported to the pulp company.
2. After reaching the pulpyard, pulpwood is measured and placed on conveyors which feed into revolving drums to remove the bark.
3. The debarked wood then moves into the chipper. The chipper is a large steel revolving disk with sharp knives set at angles. The chipper quickly reduces the sticks into millions of uniform particles known as chips.
4. The chips travel on conveyors to ten-story-high digestors called pulp cookers. Chemicals and steam are added to cook the chips into individual fibers.
5. The fibers, called wood pulp, are mixed in water and then proceed through cleaners, screens and the bleachery in preparation for the grade of paper being manufactured. At this time the pulp slurry consists of 99 percent water and one percent fiber.
6. The pulp is then sprayed thinly onto a fast-moving wire screen where the water is sucked out leaving only the fibers malted into paper.
7. The wet formed paper is then run through a series of hot rollers which press and dry it.
8. The finished paper is then rolled or cut into sheets.

INFORMATION SHEET #4

Saw Milling Lumber and Panel Products

Basically, saw milling is the process by which logs are converted into rough lumber. The following are the stages in a sawmill operation for converting a log into rough lumber.

1. The first process is to debark the log. Getting rid of the bark helps keep saws sharp longer because bark often contains grit and dirt which accumulate when the log skidded on the ground.

2. Next the log is sent to a "headrig" to be sawn. It is generally placed on a carriage or moving platform, which holds it in place as it is sawn. The sawing headrig can be either a circular saw or band saw, and some headrigs use two or more saws.

3. As boards are cut from the log, it is turned on the carriage so that other boards can be produced.

4. After the log is sawn, leftover material not suitable for lumber is sent by conveyor to a chipper where chips for paper-making purposes are produced.

5. When the rough boards leave the headrig they must go through other machines. An edger cuts the sides square and to standard widths, and a trimmer cuts the ends square and to desired lengths.

INFORMATION SHEET #5

Wood Preservation

Wood deteriorates in use just like any other material. Iron and steel rust upon exposure to the air; wood deteriorates through the action of fungi in damp moist places, or through the action of insects. To promote a long service life from wood, the following precautions should be considered.

1. The conditions that present a decay or insect problem for wood should be recognized.

2. When new construction is planned, wood should be protected from moisture and decay hazard as well as termites and other insects, through proper design and treatment.

3. For above ground use, where wood cannot be kept at least 18 inches above the surface of the ground and thus protected from excessive moisture, treated wood should be used.

4. Where wood in permanent structures is in contact with the ground, the use of a preservative is essential.

5. When decay in wood is detected, immediate corrective action to stop the wetting of wood should be taken. If this is not done, decay will only get worse. Decay-producing fungi need only a small amount of moisture on the surface of wood cells in order to grow.

6. If needed, professional advice may be obtained through a local or state forestry agency.

INFORMATION SHEET #6

Preparing Timber for Preservative Treatment

Cutting — Posts may be cut and peeled in late fall or winter so that when warm weather arrives they will be partially seasoned.

Peeling — In the treatment of posts by the nonpressure oil preservative process, it is essential that all bark be removed from the material. This permits the posts to be seasoned properly and penetrated satisfactorily by the preservative. Patches of inner bark left on the log will prevent the preservative from entering the wood. Eventually the patch will fall off, leaving exposed untreated wood.

Seasoning — For treatment with preservative oils, seasoning of wood is essential in order to obtain the best absorption and penetration of the preservative. Seasoning takes out the water and leaves room for the preservative.

The length of time to air dry or season wood depends upon such factors as climate, method of stacking, time of year, and the wood's size, species, location, and protection. Small pieces of wood season more quickly than large pieces and sapwood seasons more quickly than heartwood.

Cutting and Framing — Before any wood is treated, it should be cut and framed. This also applies to the boring of holes. Cutting after treatment exposes the untreated wood and permits entrance of fungi and insects.

Incising — Since preservative penetrates wood much farther in a longitudinal direction than in a direction perpendicular to its face, some woods are incised to provide for deeper penetration. The process involves puncturing the wood to a depth of about one-half inch down the sides of the log to increase penetration of the preservative.

INFORMATION SHEET #7

Qualities of a Good Wood Preservative

In the past, some chemical products have been recommended and sold as wood preservatives that have little preservative qualities. For this reason a woodland owner should become knowledgeable as to those preservatives which, over a period of years, have demonstrated their value by actual field test. The following are the qualities a good wood preservative should possess.

1. To preserve wood from wood-destroying fungi and insects such as termites, a good preservative must be toxic.
2. It must penetrate the wood to a sufficient depth to form an exterior shell of poisonous wood that will prevent attacks by fungi and insects.
3. It must retain its toxic effects under field conditions for a number of years.
4. It must not leak out of the wood too easily while in service.
5. A good wood preservative must be safe to handle and should not be dangerous in small concentrations to animals and humans.
6. It must not be inflammable or injurious to the wood, and should not corrode metal.
7. It must be available in the necessary quantities at an affordable price.

INFORMATION SHEET #8

Coal-Tar Creosote Preservative

Coal-tar creosote, the most widely used preservative, is a brownish or black oil made by distilling coal tar. It is practically insoluble in water and has proven to be the best preservative under conditions of water use. Its characteristics may vary due to the method of distillation and the temperature range at which the fraction of creosote was collected.

Advantages of Coal-tar Creosote

1. It is toxic to fungi and insects.
2. It is insoluble in water and makes the treated wood more resistant to weathering.
3. It does not corrode metal.
4. It is generally available.
5. It has a long record of satisfactory use.

Disadvantages of Coal-tar Creosote

1. It is naturally oily and causes treated wood to bleed.
2. It irritates the skin of some persons.
3. It has an unpleasant odor which is offensive to some persons.
4. It causes treated wood to be difficult to paint.
5. It darkens the wood surface to an unsightly dark brown or black.
6. It is of a varied chemical composition.
7. It causes treated wood to become more susceptible to fire than untreated wood.
8. Because of its toxicity, it can only be purchased and used under a license.

INFORMATION SHEET #9

Firewood as a Forestry Product

As the price of fossil fuels has increased in recent years, most smart homeowners have sought to lower their heating costs by burning wood. This has created a market for firewood. Some Illinois forest owners may be able to supplement their income through weekend woodcutting. A firewood sale of the branches and trees left after a timber sale or timber stand improvement can bring some profit from the wood that might have otherwise been wasted.

Heating Value of Wood

Wood produces less heat per pound than coal or oil. The U.S. Forest Products Laboratory makes the following comparisons.

Fuel	Amount of fuel required for one millionth British Thermal Units (BTU) of heat (cubic feet)
Aspen wood	7.0
Hickory wood	3.7
Coal	1.3
Fuel oil	0.9

Roughly speaking, a cord of dry wood weighs two tons and is equivalent to a ton of coal or 200 gallons of fuel oil as a source of heat.

Selection of Wood

Four factors should be considered in buying or selling firewood. They are:

1. Kind — Any kind of wood may be used as fuel. Some woods make better firewood than others. The heating value of dry hardwood may be judged by its weight. Generally the heavier hardwoods are considered to be better fuel than the lighter ones. Some softwoods have a higher heat value than the hardwoods because of their high resin content. Generally, firewood may be classified as follows:

   Best: Apple, Beech, Black Locust, Hedge, Hickory, Oak, Pear, Sugar Maple.

   Good: Ash, Black Cherry, Elm, Silver Maple, Walnut.

   Fair: Basswood, Catalpa, Cottonwood.

2. Moisture Content — Dry wood (less than 20 percent moisture) ignites better, is lighter, has more heat value, and causes less trouble from smoke and creosote condensation than greenwood.

3. Quality — Fuel wood is not ordinarily sold by grade. However, rotten wood has lost much of its heat value. Firewood should be protected during storage to prevent decay.

4. Size — Pieces of wood larger than eight to ten inches in diameter and 16 inches long are too large for most fireplaces. Most homeowners require that wood over ten inches in diameter be halved or quartered.

Storing Wood

Storing wood involves more than space. Considerations such as seasoning, rot, fire, and termites are important. Wood seasons faster without bark, and pieces with small diameters will air-dry quicker than large chunks. Firewood stacked in the open seasons faster than wood stacked under bushes or near buildings.

Marketing Firewood

The landowner can allow firewood purchasers to cut and scavenge downed trees in the wood lot. Alternatively, landowners can do the cutting, splitting and delivery themselves. Since the landowner is responsible for the safety of persons in the wood lot, and since higher prices can be charged for cut and delivered wood, the latter alternative is recommended.

The sale of firewood is more informal than contract timber sales. Generally a firewood seller will run an advertisement in the classified sections of local newspapers.

Firewood is usually sold by the face cord which is a stack of fireplace length logs four feet high and eight feet long. Prices charged vary with type of wood and whether it is split, seasoned, and delivered.

Wood Ashes for Fertilizer

Some homeowners question the practice of putting wood ashes on gardens and lawns. Since a standard cord of wood produces about 120 pounds of ash, the average homeowner probably would not harm the lawn or garden by using ashes in comparable quantities to those recommended by commercial fertilizers.

Fertilizer Value of Wood Ashes

Potash (K_2O) = 5 to 7 percent
Phosphoric Acid (P_2O_5) = 1 to 2 percent
Limestone equivalent ($CaCO_3$) = 50 to 70 percent

INFORMATION SHEET #10

Collecting and Making Maple Syrup

Starting a small commercial production of maple syrup and maple sugar products would require a well-spaced, conveniently-located, and productive grove of 200 - 500 mature sugar maples on one to ten acres, plus an investment of several thousand dollars in sap collecting gear, evaporators, and packaging. If goals or means are more modest, you can still enjoy homemade maple syrup from just a few trees in your back yard.

What and When to Tap

Maple syrup is made from sap drawn from certain maples in the late winter or very early spring. Trees that are ten inches in diameter are big enough to tap. Sap runs occur when temperatures fluctuate above and below freezing. Ideal conditions occur after a wet winter on days with temperatures in the 40s following nights with temperatures in the 20s or 30s. When conditions are good, a taphole may produce a gallon of sap per run.

How to Tap

Equipment — You will need a brace and 7/16 inch wood bit; a hammer; and as many sets of buckets, covers, and spiles as you have holes for. Spiles are spouts (metal or plastic tubes) that are driven into the maple trunks. The following is the procedure for tapping a tree.

1. After identifying the trees you will tap, plan the number of taps per tree.
2. For each tap, drill a three-inch deep hole in the trunk of the tree. The hole should be in sound wood, below a healthy-looking branch. The hole should be two to three feet off the ground. The hole should be straight and angle up into the center of the tree. This will help the sap drip out.
3. Once the hole is drilled, remove any loose shavings, and hammer in a clean spile. The spile should be driven in until it is firmly held in the wood of the tree.
4. Hang the bucket or sap-collecting bag on the spile. If you use buckets, they should be covered to prevent rain and debris from falling into the sap.
5. If you are placing several taps in a tree, distribute them evenly around the circumference of the trunk. If the tree has been tapped previously, new tap holes should be at least six inches away from old taps.

Collecting Sap

1. You should check your sap buckets daily.
2. Sap should be emptied into a clean collecting bucket, then transferred to a clean storage container.
3. The storage container should be thoroughly washed between batches. The key features of successful sap collection are cleanliness and cool temperatures.

Boiling the Sap

Maple syrup is sap that has been concentrated by boiling off the water. Maple sap is about 98 percent water and two percent sugar or sucrose. Syrup is about 38 percent water and 62 percent sugar.

Equipment — You will need a heat source; high-sided pans in which to boil and hold the syrup; a thermometer that registers up to 225°F; a couple yards each of clean cheesecloth and clean wool; spring-type clothespins; and clean, heat-tempered jars.

Procedure — It takes roughly 35 quarts of sap to make one quart of syrup.

1. Boil the sap as quickly as possible without scorching or burning it.
2. Filter sap through cheesecloth as you pour it into the boiling pan. This will remove dirt or debris.
3. Cover the bottom of the pan with two inches of sap and turn on the heat.
4. When half the sap has boiled off, add another inch of sap and continue boiling.
5. Continue adding sap and boiling.
6. When you have boiled down 20 inches of sap, start taking the temperature regularly. Add 7°F to the boiling temperature of your first temperature check. The sum will be the temperature at which your syrup is done.
7. Use spring-type clothespins to secure a layer of wool under several layers of cheesecloth, to the pan in which you will collect the finished syrup.

Afterwards

When the tapping season is over, be sure to remove all spiles from the trees. Wash these and all your sap and syrup equipment thoroughly. Just before re-using the sap-handling equipment, you should sterilize it with diluted chlorox solution (one part chlorox in ten parts water).

Tapping does not appear to harm trees. Individual trees have been tapped annually for a hundred years with no evident damage. Careful tapping draws less than one-tenth of a tree's reserve of sugar.

INFORMATION SHEET #11

Illinois Sawmill Directory

Adams County

Althoff Bros. Sawmill
Rt. 1, Box 143
Plainville, IL 62365
217-656-3253
Carl Althoff

Broer's Sawmill
Rt. 1
Clayton, IL 62324
217-696-2638
Robert Broer

Disselhorst Sawmill
Rt. 3
Quincy, IL 62301
217-434-8347
Glen Disselhorst

Schenk's Sawmill
Rt. 1
Plainville, IL 62365
217-656-3947
David Schenk

Tritsch Sawmill
Rt. 1, Box 93A
Quincy, IL 62301
217-885-3427
Bruce Tritsch

Withers Sawmill
Rt. 1
Quincy, IL 62301
217-222-5913
H. J. Withers

Wood Worth Sawmill
Box 2
Mendon, IL 62351
217-936-2420
Gary Woodworth

Alexander County

Kirbys Sawmill
Rt. 1
Thebes, IL 62990
618-776-5313
Elvis Kirby

Missouri Timber Export Company
P.O. Box 282
Cape Girardeau, MO 63701
314-334-3306
Gerhard Kolusch
Hickory Mill - Tamms, IL

Bond County

Prater Hardwood Lumber
Rt. 4
Greenville, IL 62246
618-664-2909
Norman L. Prater

Thick & Thin Sawmill
Rt. 1
Pocahontas, IL 62275
618-654-3226
Clarence Potthast

Boone County

Christiansen Sawmill & Logging
20080 Grade School Rd.
Caledonia, IL 61011
815-765-2008
Dale Christiansen

Brown County

Versailles Lumber Co.
Rt. 1
Versailles, IL 62378
217-225-3428
Drennan Cloyd

Bureau County

Dan DeLong Family Sawmill
& Woodshop
Box 238
LaMoille, IL 61330
815-638-2330
Dan Delong

Podolak Enterprises
Rt. 4
Princeton, IL 61356
815-447-2431
Diane D. Podolak

Scheck Sawmill
Rt. 3
Princeton, IL 61356
815-447-2342
Joe Scheck

Strader Sawmilling
305 E. Liberty St.
Walnut, IL 61376
815-379-2428
Frank L. Strader

Calhoun County

Osterman Sawmill
P.O. Box 90
Hamburg, IL 62045
618-232-1143
Larry Osterman

Edward Webb Sawmill
Rt. 1
Nebo, IL 62355
217-734-2203
Edward Webb

H. F. & L. Sawmill
Box 127
Hardin, IL 62047
618-576-2475
Paul Herkert

Carroll County

Bark & Knothole Sawmill
Rt. 1
Lanark, IL 61046
815-493-6626
Ray Bower

Kluck's Sawmill
Rt. 1, Box 86
Lanark, IL 61046
Don Kluck

Cass County

Huey Forest Products
308 S. Charles
Arenzville, IL 62611
217-997-5544
Tim Huey

Clark County

Cornwells Sawmill
Rt. 16, Box 16
West York, IL 62478
618-569-5842
Daniel R. Cornwell

Forestech Sawmill
Rt. 1
West Union, IL 62477
Phone: None
Steve Mehler or Steve Shawler

Clay County

Ames Co.
P. O. Box 481
Clay City, IL 62824
618-676-1212
Ronnie Hurd

M. D. Harmon Inc.
P. O. Drawer 5
Xenia, IL 62899
618-662-8925
M. D. Harmon

Lubert Schnautz Sawmill
P. O. Box 445
Clay City, IL 62824
618-676-1182
Lubert Schnautz

Spicer Pallet Co.
Rt. 2, Box 118
Clay City, IL 62824
618-676-1785
Hugh Lynn

Clinton County

Forth Lumber Co.
Highway 50 W
Carlyle, IL 62231
618-227-8610
Perry Forth

Kalmer Lumber & Pallet Mfg. Inc.
Albers, IL 62215
618-248-5163
Robert Kalmer

Kauling Wood Products
P. O. Box 368
Beckemeyer, IL 62219
618-594-2901
Don Kauling

Simonton Hardwood Lumber
Rt. 3
Carlyle, IL 62231
618-594-2132
Bill Simonton

Cumberland County

Will Sawmill
Siegel, IL 62462
217-844-3388
Andrew Will

Cook County

Calumet Harbor Lumber Co.
13651 S. Buffalo St.
Chicago, IL 60633
312-646-1444
Fred H. Beckman Jr.

Crawford County

Independent Stave Co.
P. O. Box 38
Flat Rock, IL 62427
618-584-3473
Ron Shrum

JAK Enterprises
P. O. Box 633
Robinson, IL 62454
618-546-5661
Harold Briner

Dekalb County

Johnson Brothers Sawmill
Genona, IL 60135
815-784-5701
Glenn Johnson

Kirkland Sawmill
606 W. Main St.
Kirkland, IL 60146
815-522-6150
Ron Sester

Dewitt County

Henry E. Lippert Sawmill
Rt. 1
Clinton, IL 61727
217-935-2655
Henry E. Lippert

John Schmidt Mill
Wapella, IL 61777
217-935-5743
John Schmidt

Edgar County

T. A. Foley Lbr. Co. Inc.
P. O. Box 336
Paris, IL 61944
217-463-6180
Stephen T. Foley

Effingham County

Otha Osteen Sawmill
Rt. 1, Box 199
Altamont, IL 62411
618-483-5586
Otha Osteen

Andrew Will Sawmill
Rt. 1
Sigel, IL 62462
217-844-3388
Andrew Will

Wilbert Ruholl Sawmill
Rt. 1
Teutopolis, IL 62467
217-857-3529
Wilbert Ruholl

Willenborg Wood & Lumber Co.
Rt. 3, Box 303
Effingham, IL 62401
217-342-4456
Clarence Willenborg

Willis Lumber Co.
1203 Temple
Effingham, IL 62401
217-342-9519
Herman Willis Jr.

Ben Winter Sawmill
Rt. 1, Box 143
Altamont, IL 62411
618-483-6665
Ben Winter

Fayette County

G & L Beaumont Lumber Co. Inc.
P. O. Box 401
Ramsey, IL 62080
618-423-2323
Jack Beaumont

C & N Wood Products
P. O. Box 217A
Ramsey, IL 62080
618-423-2156
Charles Nash

Darrell D. Weaver Lumber Co.
Rt. 1, Box 34
Shobonier, IL 62885
618-846-2275
Darrell Weaver

Wehrle Lumber Co.
Rt. 3
Vandalia, IL 62471
618-283-4859
Stanley Wehrle

Franklin County

Halleran Sawmill
Rt. 2
Mulkytown, IL 62865
618-724-9315
Jack Halleran

Malone Sawmill
Rt. 1
Benton, IL 62812
618-439-4093
Ronald Malone

Southern Illinois Tile & Lumber
Rt. 2
West Frankfort, IL 62896
618-932-6607
Howard Morgan

Sullivan Sawmill
Rt. 2
West Frankfort, IL 62966
Ray Sullivan

Twin Mills Timber & Tie
P. O. Box 34
West Frankfort, IL 62896
618-932-3662
Ed Ligon

Fulton County

Corsaw Hardwood Lumber Inc.
Rt. 1
Smithfield, IL 61477
309-293-2055
Lyndell Corsaw

Goodman Sawmill
114 Broadway
Lewistown, IL 61542
309-547-3597
Dave Goodman

Gallatin County

Bill Howard Sawmill
Rt. 1
Junction, IL 62954
618-269-4029
Bill Howard

Wenzel Construction Company
Rt. 1
Junction, IL 62954
618-269-3286
Jerry Wenzel

Greene County

Carter Sawmill
Rt. 2
Carrollton, IL 62016
217-942-6777
Marvin Carter

White Oak Sawmill
102 4th St.
Carrollton, IL 62016
217-942-6285
Larry Gibson

Grundy County

Osage Sawmill
3405 N. Route 47
Morris, IL 60450
815-942-5865
John McNabb

Hamilton County

Halls Sawmill
Rt. 5
McLeansboro, IL 62859
618-643-2496
Tom Hall

Hancock County

Cox Sawmill
Plymouth, IL 62367
309-458-6485
Lawrence Cox

Hoelschers Sawmill
Rt. 2
Plymouth, IL 62367
309-458-6627
Fred Hoelscher

Long Creek Sawmill
1890 Keokuk
Hamilton, IL 62341
217-847-2648
Alan Curtise

Hardin County

Big D Sawmill
Rt. 1
Cave-In-Rock, IL 62919
618-289-3855
Charles McDowell

Hobbs Sawmill
Rt. 1
Elizabethtown, IL 62931
No Phone
Doug Hobbs

W. T. Ozee & Sons
Rt. 2
Herod, IL 62947
618-264-5821

Henderson County

Tippett Sawmill
Rt. 3
Monmouth, IL 61462
309-768-2452
Kendall Tippett

Henry County

Ericson Log & Lumber
P. O. Box 37
New Windsor, IL 61465
309-667-2147
Sam Ericson

Hood Sawmill
1408 E. 10th St.
Kewanee, IL 61443
309-853-2921
Merle W. Hood

George Mille Sawmill
Rt. 1, Box 53
Galva, IL 61434
309-927-3873
George Mille

T. L. Schroge Custom Sawing
Rt. 1, Box 165
Colona, IL 61241
309-792-9586
T. L. Schroge

Jackson County

Morgan Sawmill & Woodworking
Rt. 2
Ava, IL 62907
618-426-3635
Clifford Morgan

Jasper County

James Acklin Sawmill
Rt. 3
Newton, IL 62448
618-783-3878
James Acklin

Kraus Brothers
Rt. 3
Oblong, IL 62449
618-592-3280
Cletus Kraus

Jefferson County

Beal & Garren
Rt. 1, Box 140
Dix, IL 62830
618-735-2056
Verneil Garren

Beckmeyer Lumber Co.
P. O. Box 128
Beckmeyer, IL 62219
618-755-4860
Jim Knapp

Paul Hart Sawmill
R.F.D.
Woodlawn, IL 62898
618-735-2885
Paul Hart

Jersey County

Ames Corp Sawmill
Rt. 1, Box 114A
Jerseyville, IL 62052
618-885-5011
C. W. Thompson

Grogan Sawmill
Rt. 2, Box 244
Jerseyville, IL 62052
618-498-2991
Murel Grogan

Hess Sawmill
Rt. 2, Box 105
Jerseyville, IL 62052
618-729-4118
Jim Hess

Klein Sawmill
Rt. 1
Grafton, IL 62037
618-786-3408
Walter Klein

Sauerwein Sawmill
101 Main St.
Fieldon, IL 62031
618-376-3522
Edwin Sauerwein

Otter Creek Sawmill
Rt. 3, Box 56
Jerseyville, IL 62052
618-498-2476
Bryan Stater

Jo Daviess County

Glen Albrecht Sawmill
3492 S. Ebys Mill Rd.
Elizabeth, IL 61028
815-858-2285
Glen Albrecht

Whip-Poor-Will Tree Farm
& Sawmill
808 S. 15th Ave.
Freeport, IL 61032
815-232-3495
Gary Keller

Woodland Wonderland Sawmill
610 Devils Ladden Rd.
Galena, IL 61036
815-777-1223
John Eisbach

Eugene Woker Sawmill
530 Mapes Scenic Dr.
Stockton, IL 61085
815-947-2022
Eugene Woker

The Woodchuck
307 Hill St., Apt. 2
E. Dubuque, IL 61025
815-747-2428
Aloysius Handfeld

Johnson County

Max P. Duer Sawmill
Tunnel Hill, IL 62991
618-658-8279
Max Duer

E & A Sawmill
Rt. 2, Box 74
Cearl Springs, IL 62922
618-996-2575
Alfred Sokolies

Kane County

Big Rock Custom Sawmill
Rt. 1, Box 423 A
Sugar Grove, IL 60554
312-556-3720
Jerry Davis

Kendal County

Nicholson Logging & Lumber
32 Gawne Ln.
Yorkville, IL 60560
312-553-5749
Dan Nicholson

Knox County

Bill's Sawmill
Rt. 1, Box 123
Dahinda, IL 61428
309-639-4418
William Patch

Lake County

Cecil Lovell Sawmill
21420 West Rt. 173
Antioch, IL 60002
312-395-8877
Cecil Lovell

Lasalle County

Burkitts Mill
Rt. 1
Streator, IL 61364
815-672-8377
Virgil Burkitt

Knoll Woodworking
Rt. 1, Box 192
Marseilles, IL 61341
815-795-5523

Nelson Hess Lumber
Rt. 1
Ottawa, IL 61350
815-434-0295
Charles Hess

Lawrence County

Kelly Bandmill Hardwood Lumber
Rt. 3, Box 288
Lawrenceville, IL 61439
618-943-4111
Marlin Mieure

Ken Neighbors Sawmill
Rt. 2
Flat Rock, IL 62427
618-928-2628
Ken Neighbors

Wagner Mill & Farms
Rt. 2
Sumner, IL 62466
618-936-2050
Kenneth Wagner

Lee County

Albrecht Sawmill
Amboy, IL 61310
815-376-7053
Clifford Albrecht

M. J. Lane Associate
Wood Products Division
Amboy, IL 61310
815-857-3731
M. J. Lane

Logan County

Ray Bernahl Sawmill
Rt. 3
Lincoln, IL 62656
217-732-8443
Ray Bernahl

McDonough County

Sears Sawmill
Rt. 1
Adair, IL 61411
Gerald Sears

McHenry County

D & R Wood Products
16306 Hebron Rd.
Alden, IL 60001
815-648-2406
Richard Huffar

Metro Wood
1808 Cresent
Crystal Lake, IL 60014
815-459-7462
Cyril Bugner

Tom Dougherty Mill
17415 B Streit Rd.
Harvard, IL 60033
815-943-6503
Tom Dougherty

McLean County

Becker Sawmill
P. O. Box 129
Stanford, IL 61774
309-379-7941
J. C. Becker

Whitmer Sawmill
Rt. 1, Box 47
Danvers, IL 61732
309-963-4262
Kenneth Whitmer

Macoupin County

Gerald Black Sawmill
Rt. 1
Raymond, IL 62560
618-854-8881
Gerald Black

Eichen Lumber Co.
Rt. 3, Box 267
Carlingille, IL 62626
217-854-9751
Chas Eichen

Harold Eichen Sawmill
Rt. 4
Carlinville, IL 62626
217-854-3026
Harold Eichen

Gibson Forest Products
Rt. 1, Box 33
Mt. Olive, IL 62069
217-839-3550
Jerry Gibson

Sloan Forest Products
Rt. 3, Box 34
Palmyra, IL 62674
217-484-6244
Omer Sloan

Marion County

Chester Burke Hardwood Lumber
P. O. Box 4
Vernon, IL 62892
618-432-5451
Chester Burke

Tony Wagner Sawmill
Rt. 1
Kinmundy, IL 61854
618-547-7411
Tony Wagner

Marshall County

Lacon Hardwood Lumber
P. O. Box 8
Lacon, IL 61540
309-246-8917
George Haley

Mason County

Hardwood Lumber Products
Rt. 1
Kilbourne, IL 62655
309-538-4411
Gary Hodgson

Snyder Hardwood Lumber Co.
P. O. Box 56
Kilbourne, IL 62655
309-538-4333
Larry Snyder

Monroe County

Dobbs Sawmill
Rt. 3
Red Bud, IL 62278
618-473-2127
Ronnie Dobbs

Lohrberg Sawmill
Rt. 3, Box 306
Waterloo, IL 62298
618-473-2704
Wm. Lohrberg

Jim Wilson Farms
Rt. 4, Box 116
Waterloo, IL 62298
618-458-6451
Jim Wilson

Montgomery County

McFarlin Milling
Rt. 3
Hillsboro, IL 62049
217-532-5006
Ted McFarlin

Morgan County

Blake Pallet Mill
P. O. Box 173
Murryville, IL 62668
217-882-7231
William Blake

Ogle County

Canfield Sawmill
Rt. 1
Chana, IL 61015
815-732-6210
Eugene Canfield

William Graehling Sawmill
Rt. 3
Polo, IL 61064
815-946-2593
William Graehling

Paul Schmidt Sawmill
Rt. 2
Polo, IL 61064
815-946-2890
Paul Schmidt

Sinnissippi Forest Products Inc.
3122 S. Lowden Rd.
Oregon, IL 61061
815-732-6168
Warren Miller

Peoria County

Phillip Edwards Sawmill
Rt. 1, Box 49AAA
Princeville, IL 61559
309-385-2258
Phillip Edwards

Blue Ridge Sawmill
Rt. 1, Box 373
Chillicothe, IL 61523
309-274-3479
Jack Donath

Snyder Sawmill
Rt. 3, Box 183A
Edelstein, IL 61526
309-249-4311
David Snyder

Sideline Sawmill
Rt. 1, 12825 N. Rt. 91
Dunlap, IL 61525
309-243-5882
David Fulton

Perry County

Barber Mine Timber Inc.
Rt. 4
DuQuoin, IL 62832
618-357-2300
Jack Mahoney

Brueggemann Sawmill
Rt. 1
Pickneyville, IL 62274
618-357-8795
Karl Brueggemann

Old DuQuoin Mill
Rt. 1, Old DuQuoin Mill
DuQuoin, IL 62832
618-542-8330
Charles Daugherty

Panther Creek
Rt. 2
Tamoroa, IL 62888
618-357-5126
Ronald Lee

Greer Enterprises, Inc.
Rt. 1
Coulterville, IL 62237
618-758-2504
Marion Greer

Tree-O-Lumber
Rt. 2, Box 366
Pickneyville, IL 62274
618-357-2576
Howard Kelly

Piatt County

Deans Sawmill
Rt. 1
New Salem, IL 62357
217-285-2230
Everett Dean

Deitzman's Sawmill
Rt. 2, Box 39
Barry, IL 62312
217-335-2054
Tom Deitzman

Dolbeare Sawmill
Rt. 1
New Canton, IL 62356
217-426-3511
York Dolbeare

Eddington Sawmill
Pearl, IL 62361
217-829-4256
Bob Eddington

Lee Lumber
Rt. 1
Pearl, IL 62361
217-829-4241
Gary Nash

Pike County

Liehr's Sawmill
102 S. Congress
Perry, IL 62362
217-236-7271
Jerry Liehr

Pope County

Jefford's Sawmill
Rt. 1
Brookport, IL 62910
618-564-3106
Aubrey Jeffords

Pulaski County

Eichhorst Sawmill
Rt. 1, Box 10
Ullin, IL 62992
618-845-2207
Roy Eichhorst

Randolph County

Jess Chandler Sawmill
Rt. 1, Box 80
Walsh, IL 62297
618-774-2992
Jess Chandler

Dickerson Sawmill
Rt. 3
Sparta, IL 62286
Walter Dickerson

Draves & Jones Sawmill
1041 William
Chester, IL 62233
618-826-3551
Harry Jones

Mika Timber Co. Inc.
P. O. Box 114
Sparta, IL 62286
618-443-5642
Robert Turner

Richland County

Hancock Lumber
Rt. 1
Noble, IL 62868
618-854-2273
Clarence Hancock

Hites Hardwood
Rt. 2
Noble, IL 61868
618-723-2136
Blaine Hites

Hoble Sawmill
P. O. Box
Nobel, IL 62868
618-723-2326
Larry Mulvey

Rock Island County

Swords Veneer & Lumber
37th Ave. & 7th St.
Rock Island, IL 61201
309-788-4515
Ronald Stetter

DeCoster's Portable Sawmilling
1317 - 102nd Ave., W.
Rock Island, IL 61201
309-794-0540
Tom DeCoster

St. Clair County

P & J Lumber & Woodcraft Products
Rt. 2, Box 168
Freeburg, IL 62243
618-539-3233
Paul & Joe Fuerer

Sangamon County

Jefferies Orchard Sawmill
Rt. 12
Springfield, IL 62707
217-487-7401
Albert Jefferies

Ed Carter Hardwood Lumber Co.
Rt. 5
Springfield, IL 62707
217-753-2773
Ed Carter

G & W Sawmill
Rt. 1
Cantral, IL 62625
217-487-7535
Merel Williams

Peters & Rohwedder Sawmill
Rt. 1
Rochester, IL 62563
217-498-7751
Don Rohwedder

Scott County

Egelhoff Lumber Company
P. O. Box 136
Manchester, IL 62663
217-587-2111
Robert Egelhoff

Shelby County

Adams Sawmill
321 N. Hanover
Moweaqua, IL 62550
217-768-4651
Kyle Adams

Compton Sawmill
Rt. 1
Shelbyville, IL 62565
217-774-2596
Paul Compton

George Schlamser Sawmill
Rt. 1
Mode, IL 62444
217-783-6308
George Schlamser

Sundown Lumber
Rt. 3, Box 130
Pana, IL 62557
217-539-4537
Clarence Schmitz

Toll Sawmill
Rt. 3
Shelbyville, IL 62565
217-774-4407
Joe Toll

Stephenson County

Iserman Sawmill
4130 Afolkley Rd.
Freeport, IL 61032
815-449-2487
Ethol Iserman

Everett Vorthmann Sawmill
1657 N. Harlem Center Rd.
Freeport, IL 61032
815-233-2442
Everett Vorthmann

Tazewell County

Dick Herm Sawmill
Rt. 2
Washington, IL 61571
309-699-2319 (home)
309-674-0224 (office)
Dick Herm

Nash Lumber Inc.
Rt. 1, Box 773
Green Valley, IL 61534
309-352-2094
James S. Nash

Pekin Hardwood Lumber
P. O. Box 277
Pekin, IL 61555
309-347-5111
Louis Pescaglia

Woodland Harvesters Inc.
P. O. Box 516
Hopedale, IL 61747
309-449-6015
Bill Steele

Union County

Jonesboro Sawmill Co.
P. O. Box 29
Jonesboro, IL 62952
618-833-4442
James Johnson

Lawrence Box & Basket Co.
P. O. Box 366
Cobden, IL 62420
618-893-2354
Randy Lawrence

Sawbro Sawmill
Rt. 1, Box 139
Buncombe, IL 62912
618-833-2883
Larry Chinners

Walkers Sawmill
Rt. 1
Anna, IL 62906
618-833-8279
Lindell Walker

Wabash County

Ed's Sawmill
P. O. Box 971
Mt. Carmel, IL 62863
618-299-5261
Ed Witkowski

William W. Newkirk Sawmill
Rt. 1
Mt. Carmel, IL 62863
618-299-3294
William W. Newkirk

Charles Pierce Sawmill (Portable)
P. O. Box 37
Lancaster, IL 62855
618-299-4641
Charles Pierce

Wayne County

L. L. Robertson Lumber Co.
Sims, IL 62886
618-895-2164
Mrs. L. L. Robertson

Harold Robertson Sawmill
Rt. 1
Geff, IL 62842
618-897-2532
Harold Robertson

McCormick Sawmill
Rt. 1
Wayne City, IL 62895
618-736-2982
Glen McCormick

Ronnie Musgrave
Rt. 2
Fairfield, IL 62837
618-842-3030
Ronnie Musgrave

White County

Taylor Sawmill Inc.
Highway 45 N.
Enfield, IL 62835
618-963-2513
Tom Harmon

Whiteside County

B & S Sawmill
13860 Damen Rd.
Morrison, IL 61270
815-772-2617
Jay Bristle

Burkholder Sawmill
305 S. Jackson
Morrison, IL 61270
815-772-4408
Dennis Burkholder

K & K Sawmill
815 S. Jefferson
Dixon, IL 61021
Daniel Keefer

West Sawmill
Rt. 4, Spring Valley Rd.
Morrison, IL 61270
815-772-7948
George West

Will County

Wassmann's Sawmill
1864 Stony Island Ave.
Crete, IL 60417
312-672-5888
Len Wassmann

Winnebago County

Back Timber & Pallet
Rt. 1
Caledonia, IL 61011
815-885-3774
Robert Bach

Patrick Sawmill
2465 Centerville
Rockford, IL 61102
815-962-0073
Maurice Patrick

Jess Pinkston Sawmill
1415 N. Horace
Rockford, IL 61100
815-965-5067
Jess Pinkston

Woodford County

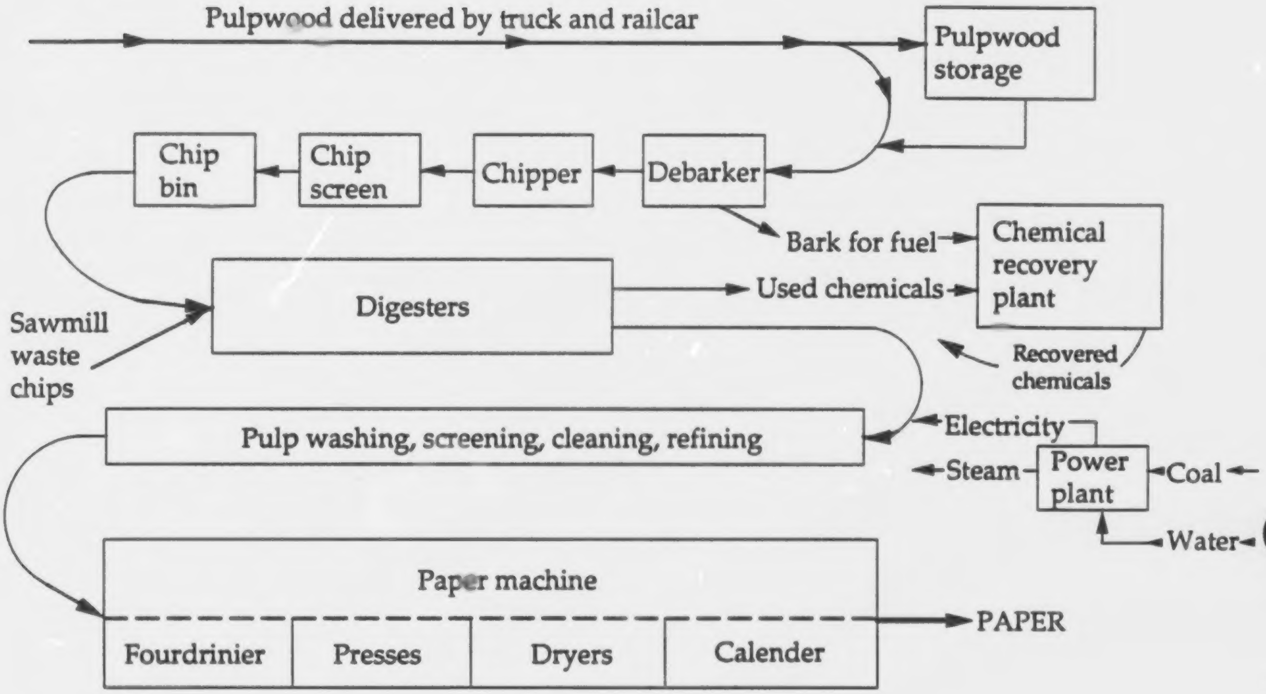
Country Time Custom Sawing
Rt. 3
Metamora, IL 61548
309-367-2671
Jim Schaidle

Sparks Sawmill
P. O. Box 273
Eureka, IL 61530
309-476-3464
Glen Sparks

Duane Steffens Mill
Rt. 1, Box 186
Carlock, IL 61725
309-376-2121
Duane Steffens

TRANSPARENCY MASTER #1

Production of Paper


Pulpwood delivered by truck and railcar
Pulpwood storage
Chip bin
Chip screen
Chipper
Debarker
Bark for fuel
Chemical recovery plant
Digesters
Used chemicals
Sawmill waste chips
Recovered chemicals
Pulp washing, screening, cleaning, refining
Electricity
Steam
Power plant
Coal
Water
Paper machine
Fourdrinier
Presses
Dryers
Calender
PAPER

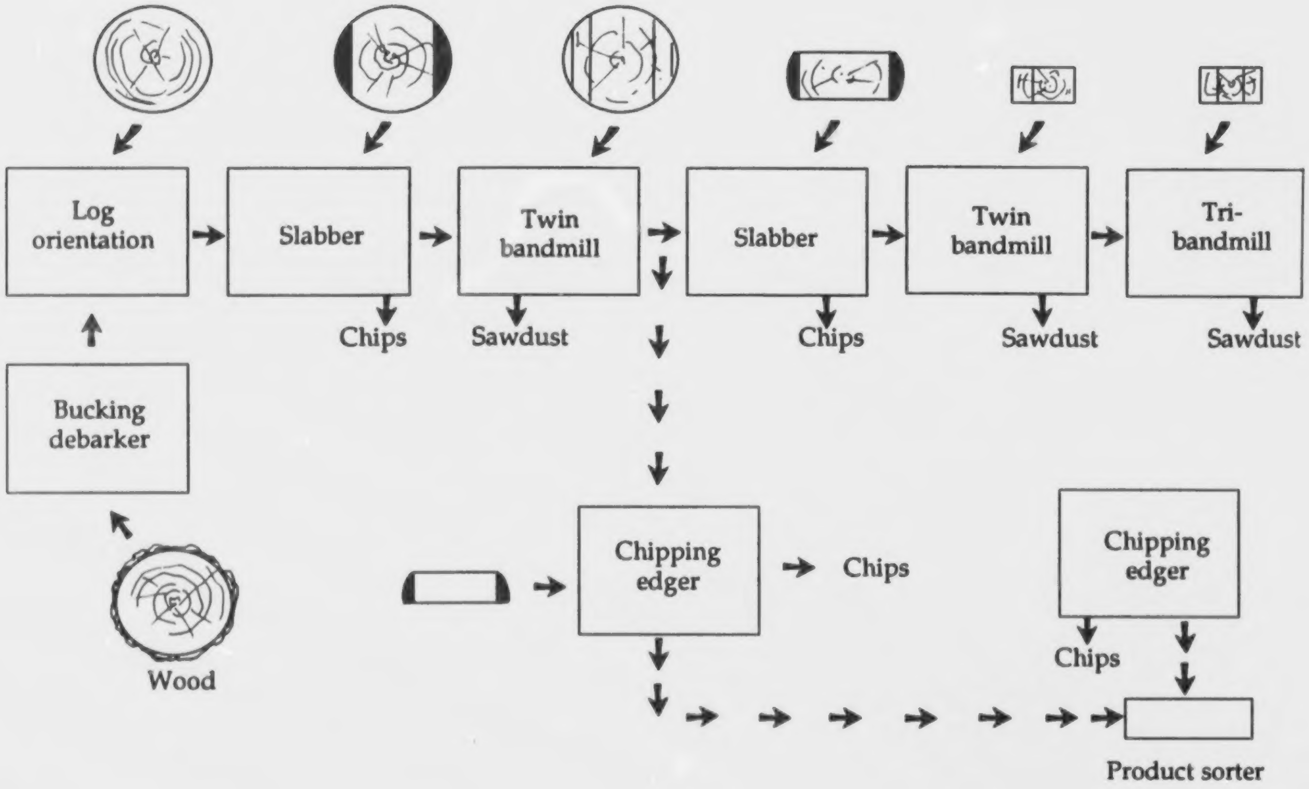
In this flow diagram showing the various processes involved in producing paper, pulpwood enters at the upper left corner and paper is produced at the lower right corner.

Paper Products

Hundreds of household and industrial products are made from paper. Many of these products require blending of various pulps to achieve desirable end-use performance qualities. A few examples are listed below:

Absorbent Papers	Printing Papers	Paper Board	Construction Papers	Specialty Papers
Toilet tissue	Newsprint	Paper cup	Insulation	Cigarette
Facial tissue	Book	Index card	Roofing	Filters
Towels	Labels	Carton	Siding	Wallpaper

Log Sawmill



Wood

Bucking debarker

Log orientation

Slabber

Chips

Twin bandmill

Sawdust

Slabber

Chips

Twin bandmill

Sawdust

Tri-bandmill

Sawdust

Chipping edger

Chips

Chipping edger

Chips

Product sorter

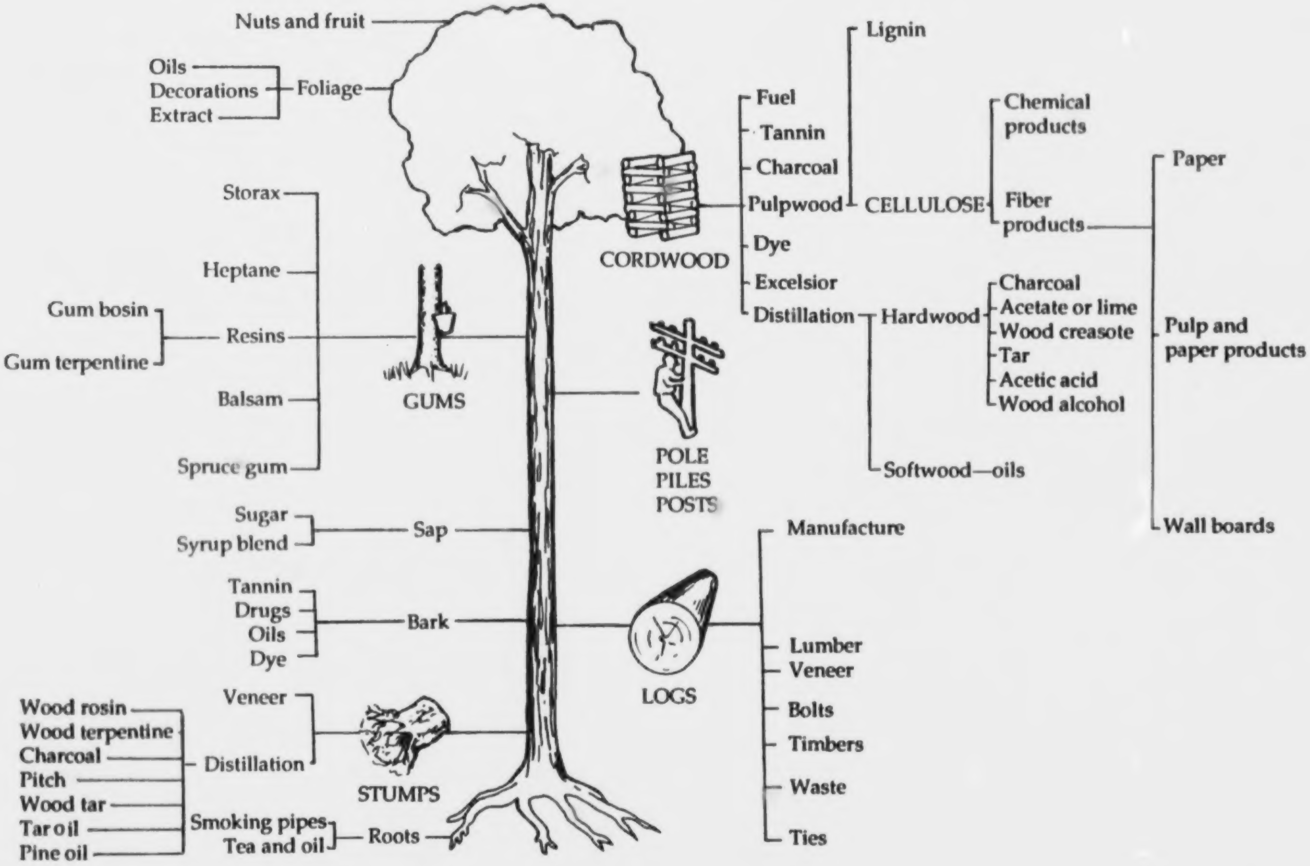
TRANSPARENCY MASTER #3

Specific Gravity of Selected Species

	Specific Gravity	
Species	Green	Air-Dry
Black locust	.66	.69
Eastern hemlock	.38	.40
Eastern white pine	.34	.35
Loblolly pine	.47	.51
Longleaf pine	.54	.59
Ponderosa pine	.38	.40
Red maple	.49	.54
Redwood (young growth)	.34	.35
Sitka spruce	.37	.40
Southern red oak	.52	.59
Tamarack	.49	.53
Western hemlock	.42	.45
White oak	.59	.67

Adapted from The Yearbook of Agriculture, *Trees*

Saw Milling Lumber and Panel Products

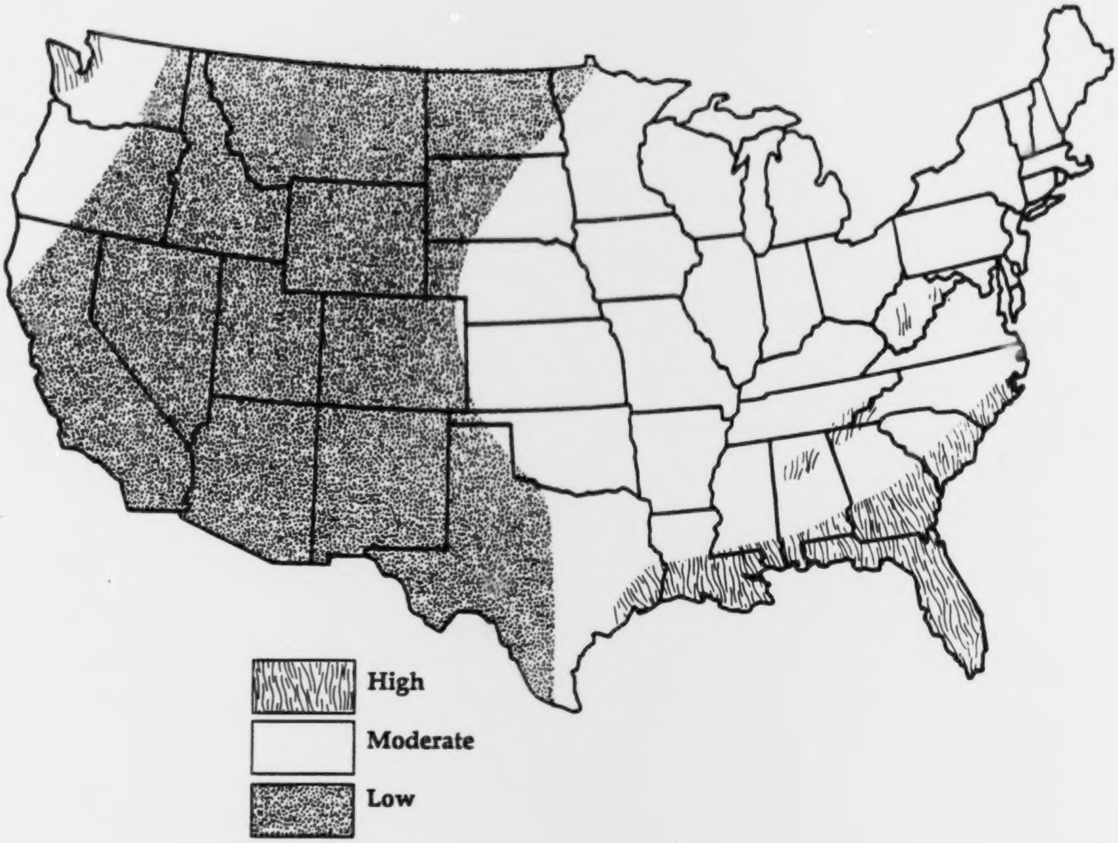

Nuts and fruit
Oils
Decorations
Extract
Foliage
Storax
Heptane
Gum bosin
Gum terpentine
Resins
Balsam
Spruce gum
GUMS
Sugar
Syrup blend
Sap
Tannin
Drugs
Oils
Dye
Bark
Veneer
Wood rosin
Wood terpentine
Charcoal
Pitch
Wood tar
Tar oil
Pine oil
Distillation
STUMPS
Smoking pipes
Tea and oil
Roots
CORDWOOD
Fuel
Tannin
Charcoal
Pulpwood
Dye
Excelsior
Distillation
Lignin
CELLULOSE
Chemical products
Fiber products
Paper
Pulp and paper products
Wall boards
Hardwood
Charcoal
Acetate or lime
Wood creasote
Tar
Acetic acid
Wood alcohol
Softwood—oils
POLE
PILES
POSTS
LOGS
Manufacture
Lumber
Veneer
Bolts
Timbers
Waste
Ties

401

402

TRANSPARENCY MASTER #5

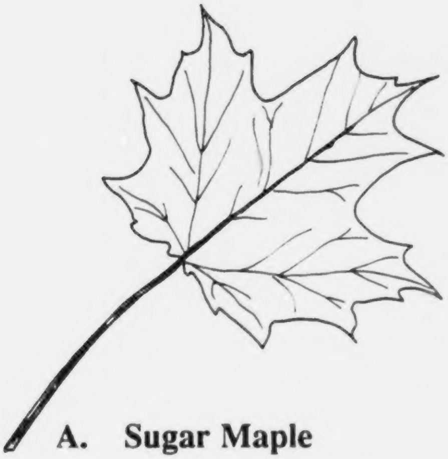
Decay Hazard



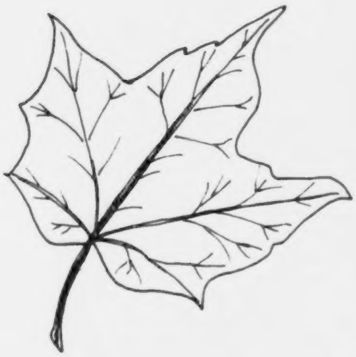
Shown on the map are three zones of decay hazard for wood used above ground. Decay hazard is greatest in regions of high rainfall and mild climate. The Southeast and Northwest are more vulnerable. (Courtesy U.S. Forest Service)

TRANSPARENCY MASTER #6

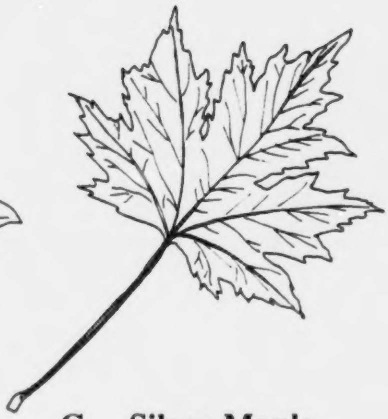
Maple Syrup Production



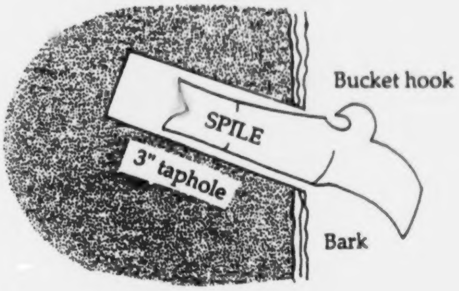
A. Sugar Maple



B. Black Maple



C. Silver Maple



Taphole with spile

Procedures: After identifying the trees you will tap, plan the number of taps per tree according to the following guide:

Tree diameter at breast height (in inches)	Circumference at breast height (in inches)	Number of taps per tree
10 — 14	31 — 45	1
15 — 19	46 — 61	2
20 — 24	62 — 76	3
25 +	77 +	4

STUDENT ACTIVITIES

STUDENT WORKSHEET #1 — Processing Questions

For additional activities, teachers may refer to the "Suggested Teaching Activities and Procedures" section in the Instructor's Guide.

STUDENT WORKSHEET #1

Processing Questions

1. Figure the weight per cubic foot of the following tree species (one cubic foot of water weighs 62.5 pounds).

	Specific Gravity		Cubic Foot Weight	
Species	**Green**	**Dry**	**Green**	**Dry**
Red Maple	.45	.54		
White Oak	.59	.67		
Black Locust	.66	.69		
Eastern White Pine	.34	.35		

2. What are ten forest products that come from trees?

3. Describe how paper is made in a pulpmill.

4. In what part of the United States is wood decay most hazardous?

5. How should wood be prepared for treatment with wood preservative?

6. What determines the quality of a wood preservative?

7. How does wood compare with coal and fuel oil as a fuel for heat production?

8. Name a tree species for each classification of fuelwood:

   Best:

   Good:

   Fair:

9. What four factors should be considered when buying firewood?

10. What are the nutrient levels of wood ashes?

11. Discuss the procedure of tapping a maple tree for sap collection.

UNIT C: Fish and Wildlife Management

PROBLEM AREAS:

1. Classifying Fish
2. Stocking Fish
3. Feeding Fish
4. Managing Fish
5. Classifying Game Birds and Animals
6. Feeding Game Birds and Animals
7. Controlling Wildlife Pests
8. Raising Game Birds and Animals
9. Maintaining Wildlife Habitat

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Classifying Fish

RELATED PROBLEM AREAS:

1. Identifying and Using Agricultural Organizations, Agencies, and Sources of Information About Agriculture (Central Core Cluster)
2. Identifying Basic Principles of Animal Science (Central Core Cluster)
3. Understanding Basic Genetics and Reproduction (Central Core Cluster)
4. Conserving Wildlife Resources (Agricultural Business and Management Cluster)
5. Understanding Animal Anatomy and Physiology (Agricultural Business and Management Cluster)
6. Meeting Environmental Requirements of Animals (Agricultural Business and Management Cluster)
7. Stocking Fish
8. Feeding Fish
9. Managing Fish

PREREQUISITE PROBLEM AREA(S):

1. Identifying Alternative Animal Production Systems: Aquaculture (Central Core Cluster)

LEVEL: Preparatory

OCCUPATIONAL TASKS ADDRESSED:

Duty B: Applying Laws, Regulations, and Policies

1. Interpret game and wildlife laws

Duty D: Managing Facility Flora and Fauna

1. Identify wildlife species within a selected area
2. Identify endangered or exotic species of plant and animal life in a selected area

Duty D: Marketing Animals and Animal Products

1. Sort and mark animals for market

Duty H: Managing the Business

1. Maintain animal records

Duty N: Breeding, Handling, and Caring for Animals

1. Mark or tag animals for identification

STATE GOALS FOR LEARNING

In planning the instruction for this problem area, teachers can promote the development of several student learning objectives which are related to the State Goals for Learning in Biological and Physical Sciences and Social Sciences. These objectives are listed on the Learning Assessment Plan forms included on the following page(s). Those learning objectives marked with an asterisk (*) are taken from the sample lists provided by the Illinois State Board of Education.

Illinois Agricultural Core Curriculum
Agricultural Education 124 Mumford Hall 1301 W. Gregory Drive University of Illinois Urbana, IL 61801

Director: Dale A. Law, Ed.D.
Principal Investigator: Jerry D. Pepple, Ed.D.
Research Assistant: Robert E. Petrea

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

Submission Date ____________________
☐ Original submission ☐ Revision
Page ____ of ____

(Affix label or complete district information.)

COUNTY	DISTRICT	ESC

District Name
City

Contact Person: ____________________
Title: ____________________
Phone: (   )

I. LEARNING AREA *(check one)*

☐ Language Arts
☐ Mathematics
☐ Sciences
☐ Fine Arts
☒ Social Sciences
☐ Physical Development/Health

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will be able to apply the skills and knowledge gained in the social sciences to decision making in life situations.

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Understand the knowledge and skills required for success in selected fields of work.					
2. Relate similarities among the species of fish and identify a species with economic potential for cultivation.					

411

ISBE 41-78 (1/88)

Submission Date ____________________
☐ Original submission ☐ Revision

Page ____ of ____

I. LEARNING AREA *(check one)*

☐ Language Arts
☐ Mathematics
☒ Sciences
☐ Fine Arts
☐ Social Sciences
☐ Physical Development/Health

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

(Affix label or complete district information.)

COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐

District Name

City

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will have a working knowledge of the social implications of technological development.

Contact Person: ____________________
Title: ____________________
Phone: (   )

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Identify materials now in use that are replacing natural resources.					
*2. Predict the consequences of technological change.					
3. Select species of fish with economic potential for cultivation and provide reasons for that potential.					

ISBE 41-78 (1/88)

Classifying Fish

4

Illinois Agricultural Core Curriculum Rev.

Agricultural Resources
Fish and Wildlife Management

Illinois Agricultural Core Curriculum Rev.

Agricultural Resources
Fish and Wildlife Management

Classifying Fish

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

Submission Date ____________________

☐ **Original submission** ☐ **Revision**

Page _____ of _____

I. LEARNING AREA *(check one)*

- ☐ Language Arts
- ☐ Mathematics
- ☒ Sciences
- ☐ Fine Arts
- ☐ Social Sciences
- ☐ Physical Development/Health

(Affix label or complete district information.)

COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐

District Name

City

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will have a working knowledge of the concepts and basic vocabulary of biological, physical, and environmental sciences and their application for life and work in contemporary technological society.

Contact Person: ____________________

Title: ____________________

Phone: (   )

III. LEARNING OBJECTIVES	IV. ASSESSMENT A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	V. EXPECTATIONS Percent of Students Expected to Achieve Objective
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:					
*1. Understand the interactions among populations of plants, herbivores, and carnivores.					
*2. Recognize that the populations of plants and animals change as the environment changes.					
*3. Compare living organisms by a classification scheme.					
4. Define terms integral to classifying fish.					
5. Identify the zoological classification of various fish species.					

ISBE 41-78 (1/88)

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Classifying Fish

STUDENT LEARNING OBJECTIVES

Upon completion of their study of this problem area, students will be able to:

1. Define terms integral to classifying fish.
2. Identify the zoological classification of various fish species.
3. Describe common methods of classifying fish.
4. Describe typical characteristics of various families of fish.
5. Relate similarities among the species of fish and identify a species with economic potential for cultivation.

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Classifying Fish

PROBLEMS AND QUESTIONS FOR STUDY **INSTRUCTOR'S NOTES AND REFERENCES**

1. What are the zoological classifications of fish?
2. Where can one find the zoological classifications of fish?
3. What are the families of fish?
4. What are some bait fish?
5. What are some pan fish?
6. What is meant by ray-finned fish?
7. What is meant by cartilaginous fish? How is a cartilaginous fish different from a bony fish?
8. What are some cool water fish?
9. What are some warm water fish?
10. How does one tell the difference between species of bass that are in the bass family and species of bass that are in the sunfish family?
11. How does one tell the difference between sport fish and cultured fish?
12. How is a carp like a goldfish?
13. How can one use information on the economic potential of certain species of fish?
14. What is the organism named "fish" that really isn't a fish at all?

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Classifying Fish

SUGGESTED TEACHING ACTIVITIES AND PROCEDURES

1. Use resource persons from the Illinois Department of Conservation (Division of Fisheries, Division of Wildlife), Illinois Natural History Survey Fish Biologists, Cooperative Extension Service, U.S. Forest Service, Fish and Wildlife Service (U.S. Department of Interior), local aquaculturists, local sport fishing organizations, and the Illinois Aquaculture Industry Association for more specific information as required by students.

2. Conduct field trips to local impoundments such as ponds or reservoirs to observe and study fish in their natural habitat.

3. Conduct a field trip to the local pet store to observe the various species of fish available for purchase and differences in species requirements.

4. Use reference texts and publications as student resources for additional specific species information.

5. Use the prerequisite problem area *Identifying Alternative Animal Production Systems: Aquaculture* as a resource for general aquaculture information and specific information on fish environmental requirements.

6. Have students who fish regularly give presentations on specific species of fish and the various techniques used for catching those fish. Prompt students with questions on how those techniques reflect characteristics found in the various fish families.

7. Use local sport fishing organizations, such as bass clubs, as a source of specimens of various fish for class viewing.

8. Lead students in a discussion of the impact of the fishing and aquaculture industry on the local economy.

9. Use the information sheets for general background information on fish classification systems and evolution.

10. Have students identify a fish product that they like. Have the students conduct research into the classification of that fish and its characteristics such as region located, water temperature preferred, feeding habits, mating habits, etc.

11. Consider using an aquarium as a classroom tool for investigation into fish and fish habits.

12. Use the various classifications of fish as starting points for use in SAE or SOE projects.

13. Use Student Worksheet #1 as a classroom activity to begin or add to a specimen collection. These specimens can be obtained from students or local sportsmen. Use the worksheet discussion guide for additional information.

14. Obtain copies of Department of Conservation, Division of Fisheries publications such as *Fishing Lake Michigan*, *Lake Shelbyville Fishing Guide*, *Carlyle Lake Fishing Guide*, or *Clinton Lake Access Areas and Fishing Guide* for use as student references for specific species information and habits.

15. Student Worksheet #1 can be expanded by inviting a local taxidermist to demonstrate techniques used in the taxidermy profession.

16. Another expansion of Student Worksheet #1 is to preserve specimens by using crystal embedding kits available from Nasco or Carolina Biological.

17. Invite a conservation police officer to address the class on the various aspects of conservation law in general and game seasons in particular.

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Classifying Fish

SUGGESTED TEACHING ACTIVITIES AND PROCEDURES (con't.)

18. Refer to the problem area *Stocking Fish* for a listing of contact persons, agencies and additional resources available that provide information relative to aquaculture.

19. Obtain copies of *Specialty Animal Production Curriculum Guide for Vocational Agriculture/ Agribusiness* (Bulletin #1806) for information on raising crawfish, bees, worms, crickets and bob-white quail for use as possible classroom activities.

INSTRUCTOR'S NOTES AND REFERENCES

420

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Classifying Fish

REFERENCES

*1. *Action for the Nineties . . . And Beyond; What Fish is This?* Illinois Department of Conservation, Division of Fisheries, 600 N. Grand Avenue West, Springfield, IL 62706. (217) 782-6424.

*2. *The Aquaculture Industry in Illinois.* Waite, S. W., Waite, J. L. (1989). Aquaculture Resources Midwest, 1906 Hemlock Drive, Champaign, IL 61821.

3. *Fish Farming Handbook.* Brown, E. E., Gratzek, J. B. (1980). AVI Publishing Company, Inc., Division of Van Nostrand Reinhold, 115 Fifth Avenue, New York, NY 10003-1004. (212) 254-3232.

4. *Grzimek's Animal Life Encyclopedia.* Grzimek, B., ed. (1974). International Specialized Books, 5602 N.E. Hassalo Street, Portland, OR 97213. (800) 547-7734.

5. *Commercial Catfish Farming.* Lee, J. S. Interstate Publishers, Inc., P.O. Box 50, Danville, IL 61834-0050. (217) 446-0500.

*6. *The Illinois Aquaculture Industry Association.* P.O. Box 2901, 1701 Towanda Avenue, Bloomington, IL 61701. (309) 557-2105.

*7. *Freshwater Fish Species (8985-C); Saltwater Fish Species Identification (8985-D).* Instructional Materials Service, Texas A & M University, F. E. Box 2588, College Station, TX 77843-2588.

8. *Integrated Principles of Zoology.* Hickman, Jr., C. P., Roberts, L. S., Hickman, F. M. (1988). Time Mirror/Mosby College Publishing, 11830 Westline Industrial Drive, St. Louis, MO 63146.

*9. *Wildlife Conservation and Management Curriculum Guide for Vocational Agriculture/Agribusiness* (#1853); *Specialty Animal Production Curriculum Guide for Vocational Agriculture/Agribusiness* (#1806). Louisiana Department of Education, Office of Vocational Education, P. O. Box 94064, Baton Rouge, LA 70804-9064.

10. *The Crayfishes and Shrimps (Decapoda) of Illinois* (Bulletin #33-4). (1985). Page, L. M. The Illinois Natural History Survey, 607 East Peabody, Champaign, IL 61820.

*11. *Fishes of the World.* (1984). Nelson, J. S. Second edition. Wiley-Interscience, John Wiley and Sons, Inc., 605 Third Avenue, New York, NY 10158-0012.

*12. *Checklist of Endangered and Threatened Animals and Plants of Illinois.* (March 1989). Illinois Department of Conservation, Division of Fisheries, 600 N. Grand Avenue West, Springfield, IL 62706. (217) 782-6424.

*Indicates highly recommended reference

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTIONAL RESOURCES

These resources are intended for use by teachers in planning and teaching the materials for this problem area and may be adapted to fit the teaching method(s) used.

INFORMATION SHEET #1 — Fish Ancestry

INFORMATION SHEET #2 — Fish Classification

INFORMATION SHEET #3 — Common Classifications

INFORMATION SHEET #4 — Threatened and Endangered Fish

TRANSPARENCY MASTER #1 — Fish Scale Types (with discussion guide)

TRANSPARENCY MASTER #2 — Superclass: Agnatha, and
Superclass: Gnathostomata (with discussion guide)

TRANSPARENCY MASTER #3-10 — Class: Osteichthyes (with discussion guide)

INFORMATION SHEET #1

Fish Ancestry

While the definitive answer to the evolution and origin of the chordates in general, and the fishes in particular, is subject to continuing debate, there are similarities among the group as a whole. Among the basic similarities are bilateral symmetry, differentiated germ layers, a well-developed coelom (body cavity), segmented muscles, a closed blood system with a ventral heart, a complete digestive system, an endoskeleton, a notochord (skeletal rod) present at some time, and a single, dorsal, tubular nerve cord which is usually enlarged at the anterior end.

The subphylum Vertebrata begins the grouping which shares the basic characteristics of the chordates in addition to having a spinal column of vertebrae, which forms the skeletal axis of the body, and a cranium, or braincase. In addition to these two characteristics are an integumentary system with at least an epidermis and dermis (inner connective tissue), muscles attached to the skeleton, excretory system with paired kidneys, an endocrine system, a segmented brain, cranial nerve pairs, generally separate sexes, and a body plan of head, trunk, and postanal tail.

The fishes (Pisces) themselves begin with the Agnatha superclass and contain the jawless hagfishes and lampreys which are thought to resemble the ancient ancestors. While these two have similarities of body shape, cartilaginous skeleton, soft skin with mucous glands, external fertilization, and the absence of scales, appendages, and stomach. There are enough differences to warrant separate classes. Differences can be found in kidney function, number of gills, feeding habits, and absence of a larval stage in the hagfishes.

The class Chondrichthyes includes the sharks, skates, and rays. The class Chondrichthyes is the beginning of the superclass Gnathostomata. The basic distinguishing feature is the jawed mouth. This group is considered higher in the evolutionary chain and more recent in development. One of the distinctive features is the entirely cartilaginous skeleton which contains some calcification but no bone. Except for whales, sharks are the largest vertebrates. Other distinctive features include internal fertilization, a fusiform body, a heterocercal caudal fin, a ventral mouth, no swim bladder or lung, gonad pairs, placoid scales on skin and modified placoid scales for teeth, pairs in circulatory branches, and direct development of young.

The group of fish which midwesterners are most familiar with are the bony fishes in the class Osteichthyes. While most fish common to this area have trim, elongated bodies efficient for speed and predation, some have flattened bodies for bottom feeding and concealment, and others are pipelike, bulbous, or simply changeable to fit the immediate requirements. There are many physiological and anatomical specializations. However there are common characteristics such as a bony skeleton; a homocercal tail (as on perch); swim bladder; blood with nucleated red cells; usually external fertilization; ganoid, cycloid, or ctenoid scales; fin rays of cartilage or bone; and a brain with large optic lobes and cerebellum.

The class Osteichtyes contains three subclasses and 45 living orders. The subclass Crossopterygii contains only one living order. The coelacanth was thought extinct until a live specimen was found in 1938. This type of lobe-finned (fleshy bone) fish had lungs as well as gills, and they are thought to have gone from puddle to puddle, pulling themselves along on their lobes.

The subclass Dipneusti contains two living orders of lungfish. These three genera are capable of gulping air. Two of the genera are capable of living out of water and are able to burrow into the mud as the dry season approaches. The fish secretes a slime that is mixed with mud to form a cocoon-like environment in which the creature estivates until rain returns.

The subclass Actinopterygii contains the ray-finned fishes which are the common sport and commercial fishes. The sturgeons and paddlefish (Chondrostei) are considered to be the most primitive. The gars and bowfins (Holostei) are considered to be less primitive. The superorder Teleostei contains the modern bonyfishes. This group encompasses the goldfish and other ornamentals found in home aquariums; sportfish like trout, bass, bluegill, catfish and salmon; and the various fishes of a more commercial nature.

INFORMATION SHEET #2

Fish Classification

Kingdom: Animalia

Phylum: Chordata

Subphylum: Vertebrata

Superclass: Agnatha (Jawless, cartilaginous skeleton, no ventral fin)

Class: Myxini (Hagfish)
Class: Cephalaspidomorphi (Lampreys)

Superclass: Gnathostomata (Jaws present, paired limbs, notochord)

Class: Chondrichthyes (Cartilaginous skeleton, teeth not fused to jaw, no swim bladder)

Subclass: Elasmobranchii (Sharks, rays)
Subclass: Holocephali (Chimaeras)

Class: Osteichthyes (Primitive one piece body, with various modifications; mostly ossified skeleton; swim bladder)
Taleostomi — bony fish

Subclass: Crossopterygii (Coelacanth)
Lobe-finned fish

Subclass: Dipneusti (Neoceratodus)
Lungfish

Subclass: Actinopterygii
Ray-finned fish

Superorder: Chondrostri — Primitive ray-finned fish
(Sturgeons, paddlefish)

Superorder: Holostei — Intermediate ray-finned fish
(bowfin, gar)

Superorder: Teleostei — Modern ray-finned fish
(35 living orders, representing 95% of all living fish)

(See transparency master discussion guide for order, family, genus, species of specific fish.)

INFORMATION SHEET #3

Common Classifications

Cool water Fish
- Trout
- Muskie
- Northern Pike
- Walleye
- Sauger
- Hybrid Striped Bass

Warm water Fish
- Catfish
- Bluegill
- Carp
- Crappie
- Minnows
- Largemouth Bass
- Redear
- Goldfish

Pan Fish
- Crappie
- Yellow and White Bass
- Bluegill
- Bullhead
- Yellow Perch
- Redear

Stream Fish
- Fast — Trout
  - Shiner
  - Darter
- Slow — Sucker
  - Catfish
  - Perch

Dissolved Oxygen Required
- High — Trout
  - Walleye
  - Char
  - Shiner
  - Darter
- Low — Bass
  - Pike
  - Sucker
  - Catfish
  - Sunfish
  - Carp
  - Yellow Perch

Rough Fish
- Carp
- Buffalo
- Drum

Bait Fish
- Golden Shiner
- Flathead Minnows
- Carp Suckers
- Goldfish
- Gizzard Shad
- Threadfin Shad
- Mooneye
- Bluntnose Minnow
- Creek Caub
- Crayfish

Tropical — Ornamental

Those species raised primarily for use in indoor aquariums for personal enjoyment

Sport Fish

Those species (both native and introduced) which are primarily taken for personal use and/or to enjoy the recreational activity of fishing

Elements Used in Zoological Classifications
- Symmetry
- Feeding habits
- Number of spines (hard or soft) in fins
- Number of rays (hard or soft)
- Scale type
- Tooth type and size
- Skeleton type
- Location of specific body parts
- Extent of nervous system
- Extent of circulatory system
- Extent of digestive system
- Fin type
- Swim bladder function
- Body type
- Mouth location
- Appendages present
- Extent of sense organs and location
- Reproduction mode
- Integument
- Respiration mode
- Muscle structure

INFORMATION SHEET #4

Threatened and Endangered Fish

Definitions

Federally Endangered Species — Any species which is in danger of extinction throughout all or a significant portion of its range.

Federally Threatened Species — Any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

State Endangered Species — Any species which is in danger of extinction as a breeding species in Illinois.

State Threatened Species — Any breeding species which is likely to become a state endangered species within the foreseeable future in Illinois.

Take — In reference to animals and animal products, to harm, hunt, shoot, pursue, lure, wound, kill, destroy, harass, gig, spear, ensnare, trap, capture, collect, or to attempt to engage in such conduct; in reference to plants and plant products, to collect, pick, cut, dig up, kill, destroy, bury, crush, or harm in any manner.

Fishes

Endangered

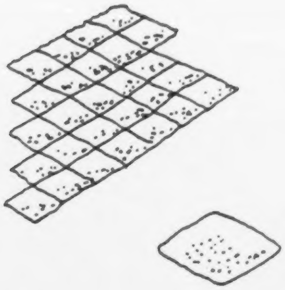
Northern Brook Lamprey	*Ichthyomyzon fossor*
Bigeye Chub	*Hybopsis amblops*
Pallid Shiner (Chub)	*Notropis (Hybopsis) amnis*
Pugnose Shiner	*Hotropis anogenus*
Bluehead Shiner	*Notropis hubbsi*
Weed Shiner	*Notropis texanus*
Cypress Minnow	*Hybognathus hayi*
Greater Redhorse	*Moxostoma valenciennesi*
Northern Madtom	*Noturus stigmosus*
Western Sand Darter	*Ammocrypta clara*
Eastern Sand Darter	*Ammocrypta pellucida*
Bluebreast Darter	*Etheostoma camurum*
Harlequin Darter	*Etheostoma histrio*

Threatened

Least Brook Lamprey	*Lampetra aepyptera*
Lake Sturgeon	*Acipenser fulvescens*
Alligator Gar	*Lepisosteus spatula*
Cisco	*Coregonus artedii*
Lake Whitefish	*Coregonus clupeaformis*
Bigeye Shiner	*Notropis boops*
Ironcolor Shiner	*Notropis chalybaeus*
Blackchin Shiner	*Notropis heterodon*
Blacknose Shiner	*Notropis heterolepis*
River Redhorse	*Moxostoma carinatum*
Longnose Sucker	*Catostomus catostomus*
Banded Killifish	*Fundulus diaphanus*
Spotted Sunfish	*Lepomis punctatus*
Bantam Sunfish	*Lepomis symmetricus*
Iowa Darter	*Etheostoma exile*

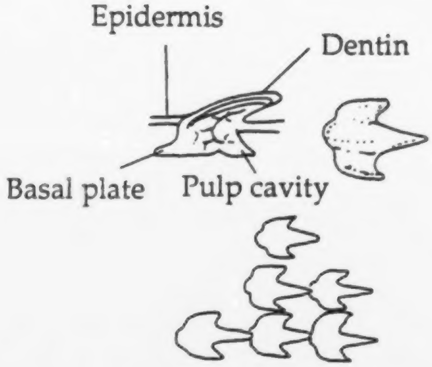
TRANSPARENCY MASTER #1

Fish Scale Types



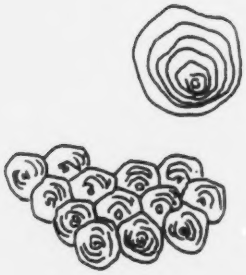
Granoid scales

Found on
Gar


Epidermis
Dentin
Basal plate
Pulp cavity

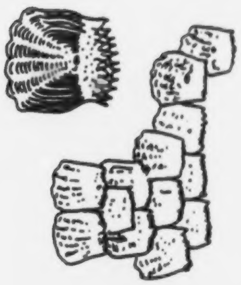
Placoid scales

Found on
Chondrichthyes



Cycloid scales

Found on
Teleosts



Ctenoid scales

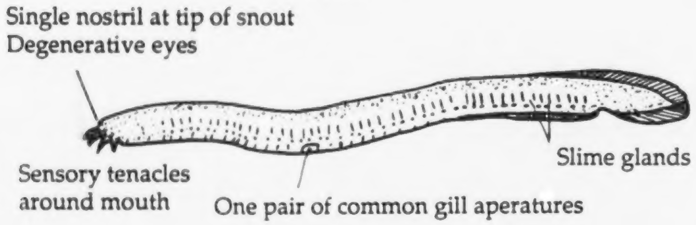
Found on
Teleosts

TRANSPARENCY MASTER #2

Superclass: Agnatha

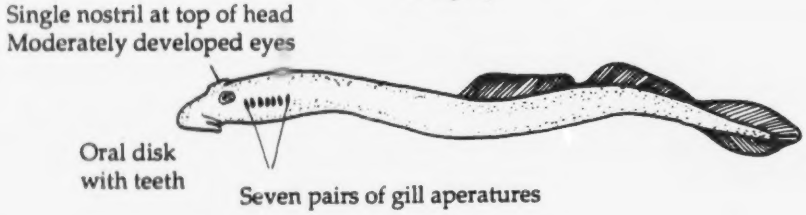
Class: Myxini

Hagfish


Single nostril at tip of snout
Degenerative eyes
Slime glands
Sensory tenacles around mouth
One pair of common gill aperatures

Class: Cephalaspidomorhi

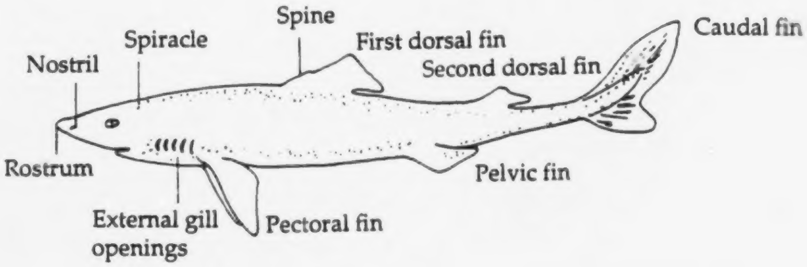
Lamprey


Single nostril at top of head
Moderately developed eyes
Oral disk with teeth
Seven pairs of gill aperatures

Superclass: Gnathostomata

Class: Chondrichthyes

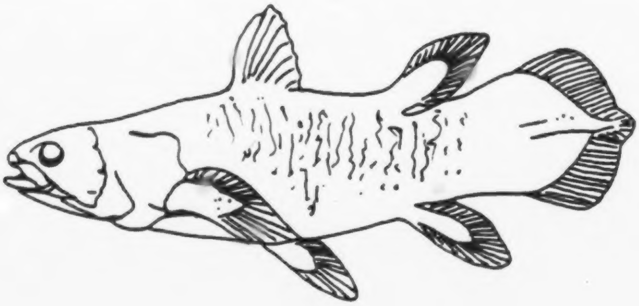
Dogfish shark - Squalus acanthias
Subclass - Elasmobranchii


Spine
Caudal fin
Spiracle
First dorsal fin
Nostril
Second dorsal fin
Rostrum
Pelvic fin
External gill openings
Pectoral fin

TRANSPARENCY MASTER #3

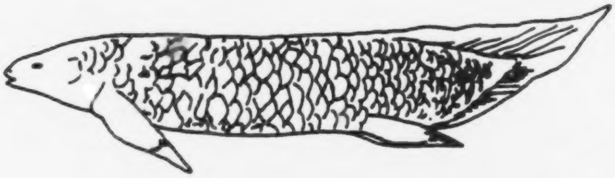
Class: Osteichthyes

Subclass: Crossopterygii



Sole Surviving Member — Coelacanth

Subclass: Dipneusti

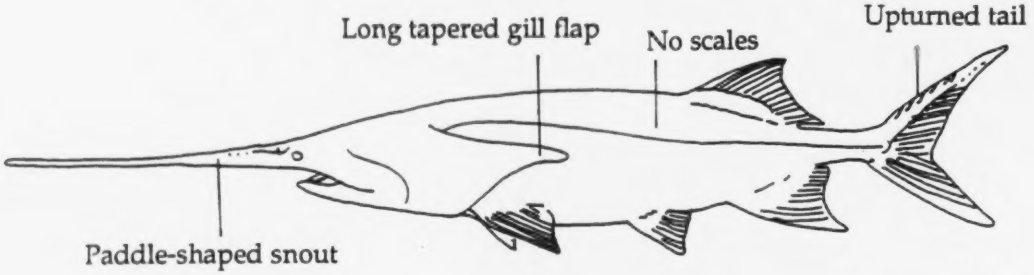


Neoceratodus — can gulp air but cannot live out of water

TRANSPARENCY MASTER #4

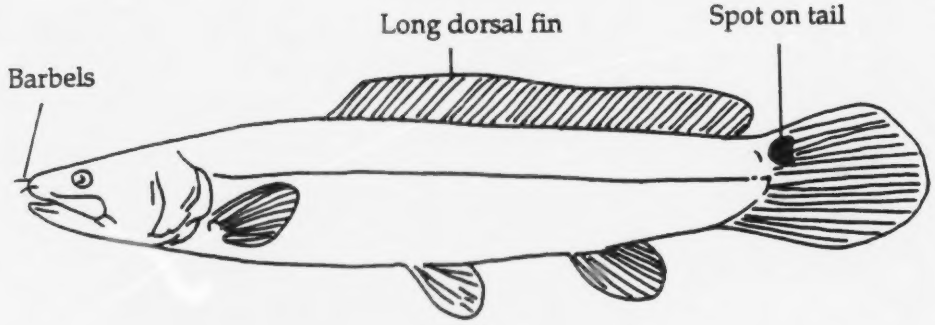
Subclass: Actinoptergygii

Superorder: Chondrostei


Long tapered gill flap
No scales
Upturned tail
Paddle-shaped snout

Paddlefish
(Polyodon spathula)

Superorder: Holostei


Long dorsal fin
Spot on tail
Barbels

Bowfin
(Amis calva)

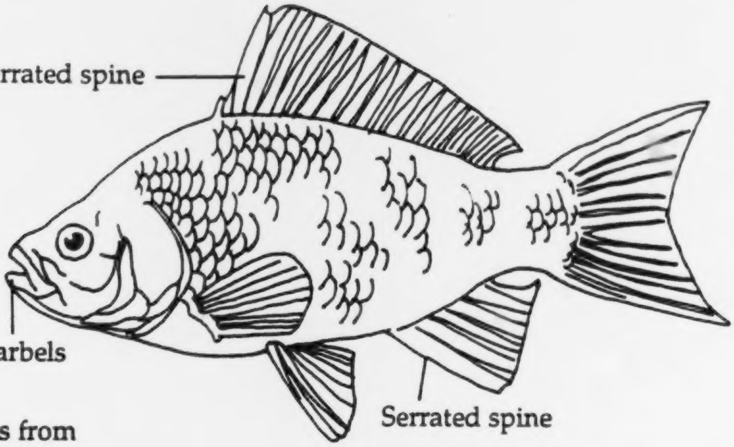
430

TRANSPARENCY MASTER #5

Subclass: Actinopterygii

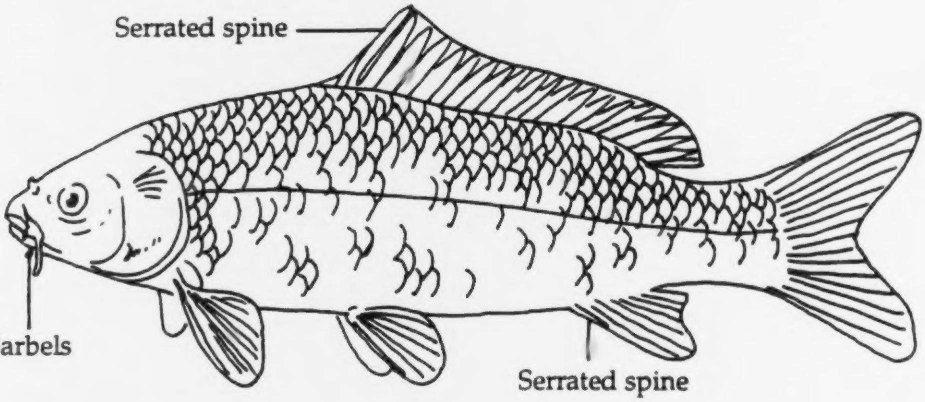
Superorder: Teleostei

Minnow Family


Serrated spine
No barbels
Serrated spine

Color varies from gold to olive brown

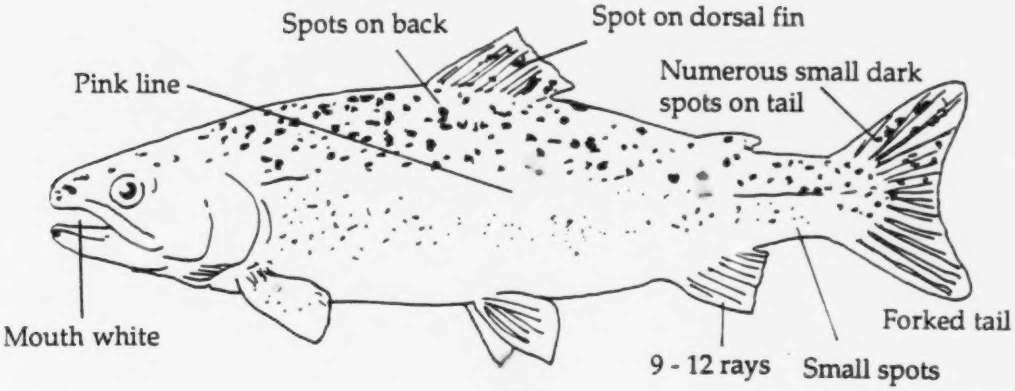
Goldfish
(Carassius)


Serrated spine
Barbels
Serrated spine

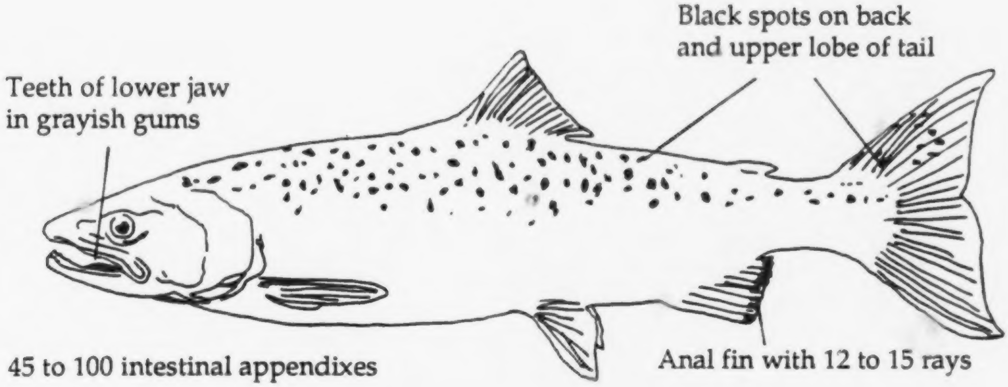
Carp
(Cyprinus carpio)

TRANSPARENCY MASTER #6

Salmon Family


Spots on back
Spot on dorsal fin
Pink line
Numerous small dark spots on tail
Mouth white
Forked tail
9 - 12 rays
Small spots

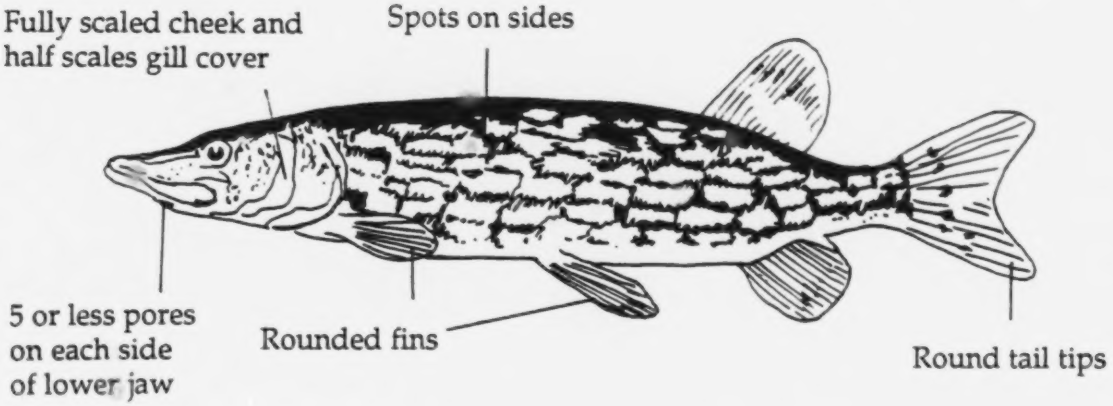
Rainbow trout
(Oncorhynchus mykiss)


Black spots on back and upper lobe of tail
Teeth of lower jaw in grayish gums
45 to 100 intestinal appendixes
Anal fin with 12 to 15 rays

Coho salmon
(Oncorhynchus kisutch)

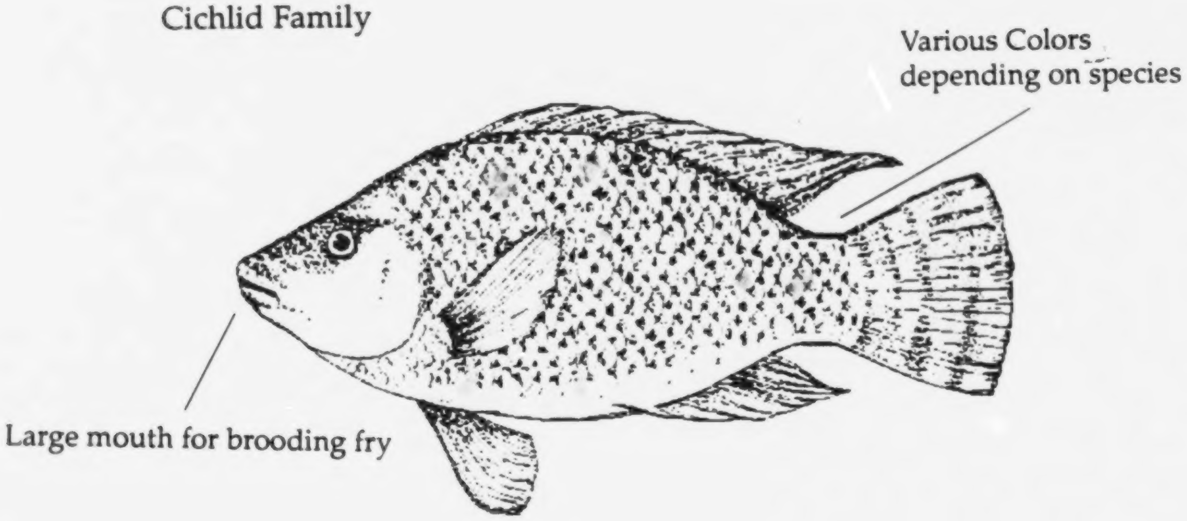
TRANSPARENCY MASTER #7

Pike Family


Fully scaled cheek and half scales gill cover
Spots on sides
5 or less pores on each side of lower jaw
Rounded fins
Round tail tips

Northern pike
(Esox lucius)

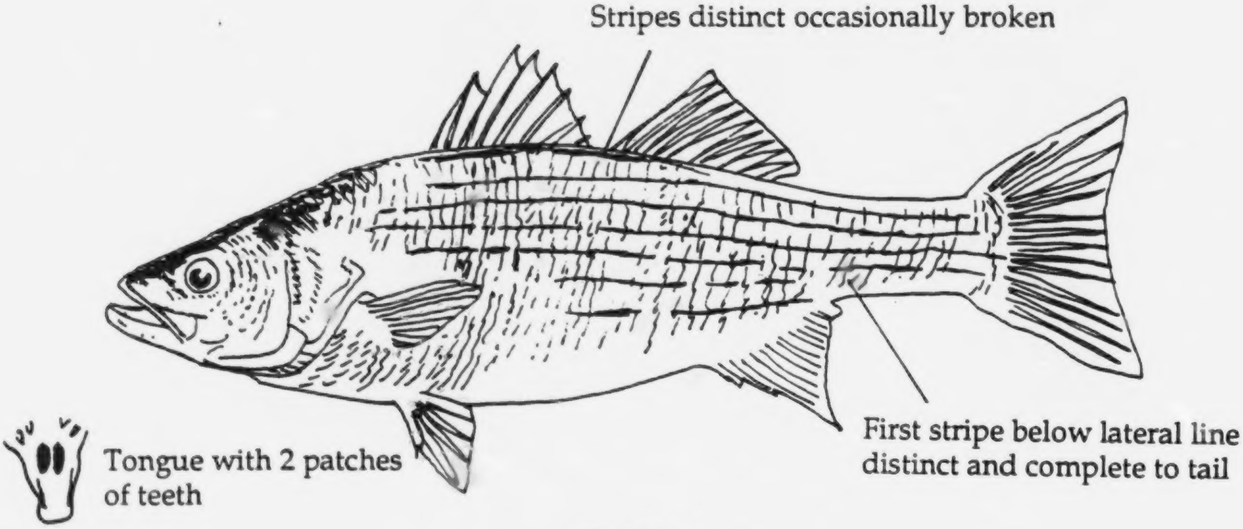
Perch Suborder
Cichlid Family


Various Colors depending on species
Large mouth for brooding fry

Tilapia
(Tilapia species varied)

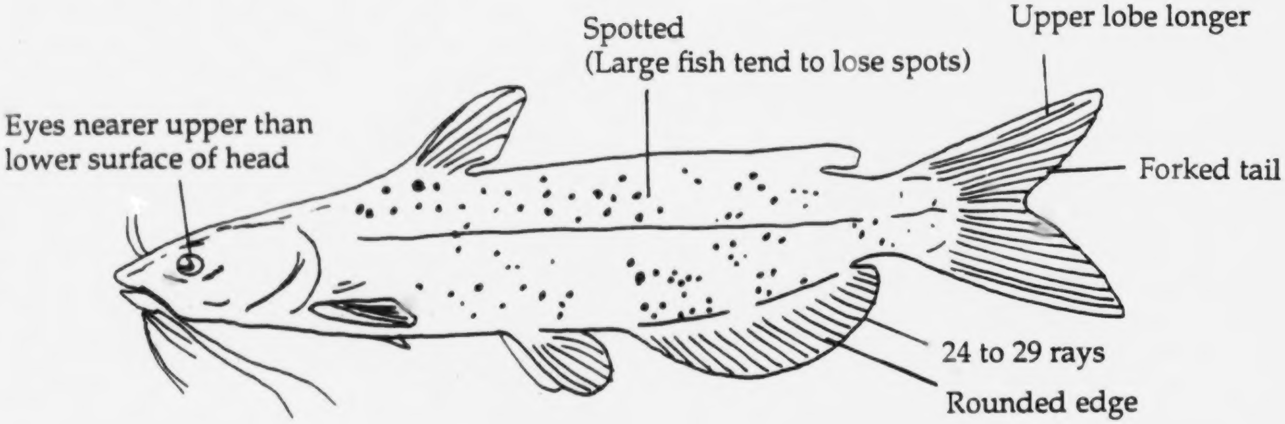
TRANSPARENCY MASTER #8

Bass Family


Stripes distinct occasionally broken
Tongue with 2 patches of teeth
First stripe below lateral line distinct and complete to tail

Striped bass
(Morone saxatilis)

Catfish Family

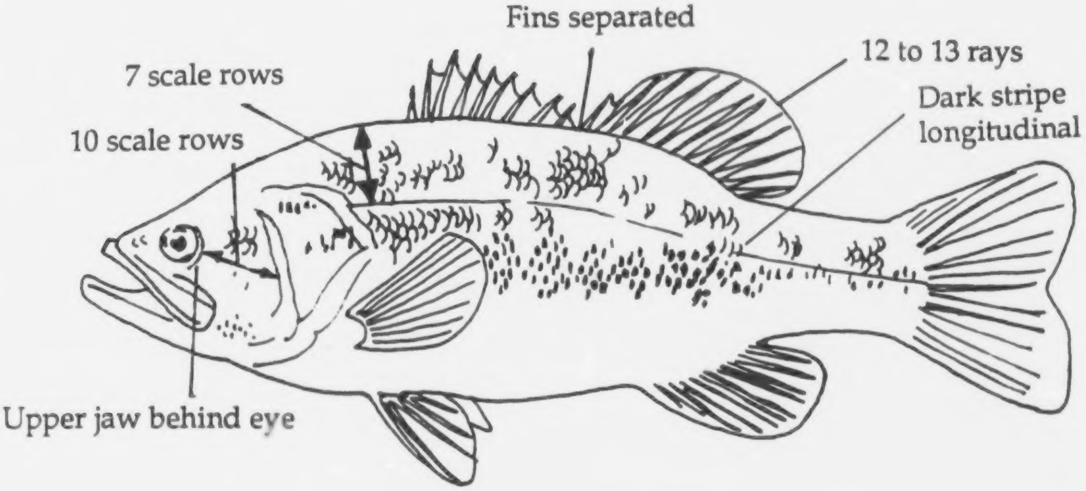

Spotted
(Large fish tend to lose spots)
Upper lobe longer
Eyes nearer upper than lower surface of head
Forked tail
24 to 29 rays
Rounded edge

Channel catfish
(Ictalurus punctatus)

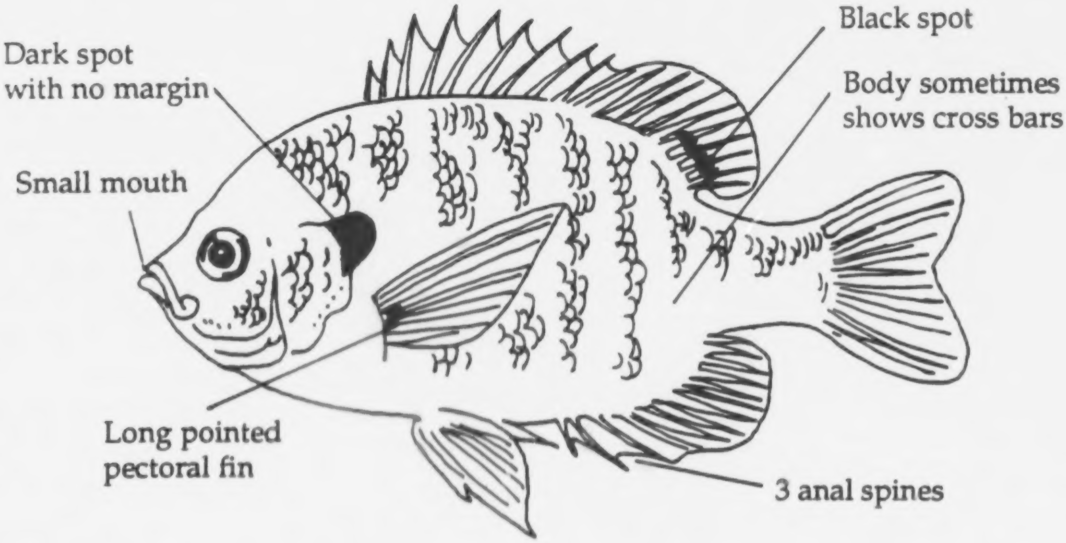
434

TRANSPARENCY MASTER #9

Sunfish Family


Fins separated
12 to 13 rays
7 scale rows
Dark stripe longitudinal
10 scale rows
Upper jaw behind eye

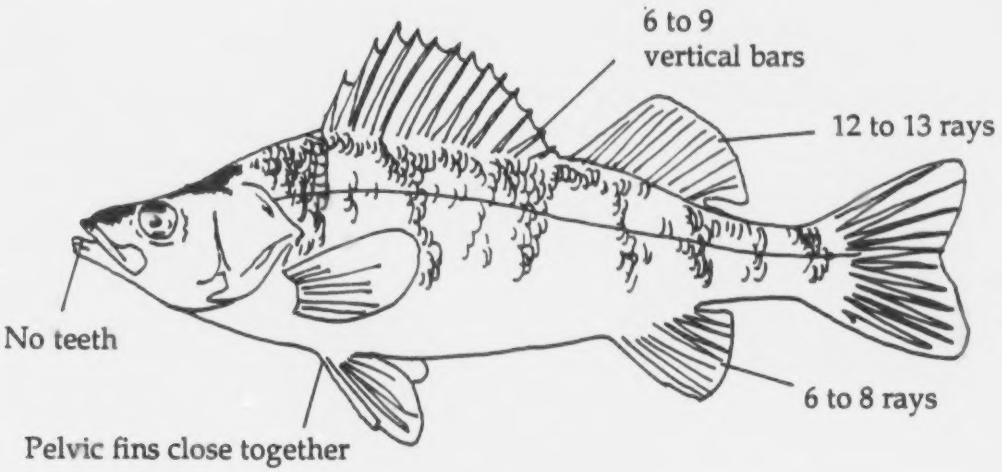
Largemouth bass
(Micropterus salmoides)


Black spot
Dark spot with no margin
Body sometimes shows cross bars
Small mouth
Long pointed pectoral fin
3 anal spines

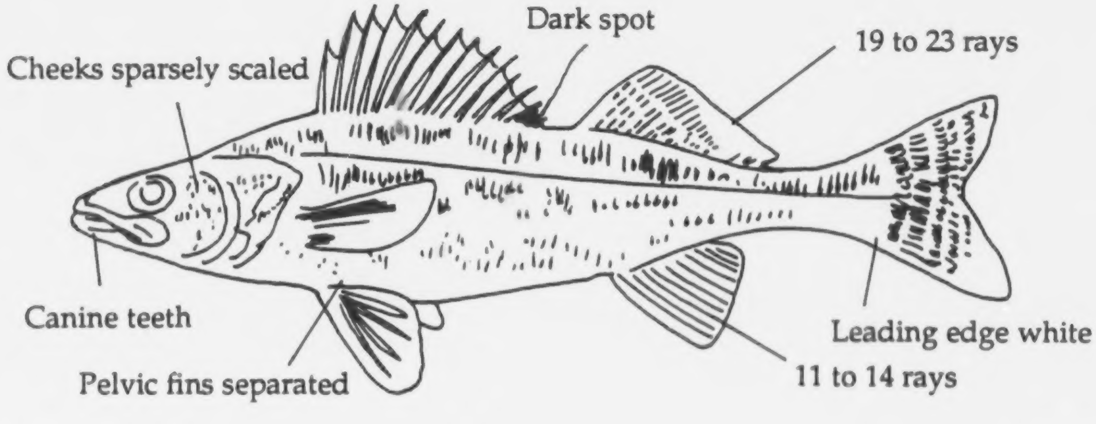
Bluegill
(Lepomis macrochirus)

TRANSPARENCY MASTER #10

Perch Family


6 to 9
vertical bars
12 to 13 rays
No teeth
6 to 8 rays
Pelvic fins close together

Yellow perch
(Perca flavescens)


Dark spot
19 to 23 rays
Cheeks sparsely scaled
Canine teeth
Leading edge white
11 to 14 rays
Pelvic fins separated

Walleye
(Stizostedion vitreum)

TRANSPARENCY MASTER DISCUSSION GUIDE

Transparency Master #1

A. Placoid scales found on some sharks and rays; some species are scaleless.

B. Ganoid scales found on primitive, extinct, heavily armored fish, and on living species of gar and others.

C. Ctenoid and cycloid scales found on living bony fish; similar in structure with the ctenoid having the spiked edges.

Transparency Master #2*

A. Superclass: Agnatha
Class: Cyclostomata
Subclass: Myxini
Family: Myxinidae
Subfamily: Myxininae
Genus: Myxine
Species: glutinosa
Class: Cephalaspidomorphi
Family: Petromyzontidae
Subfamily: Petromyzoninae
Genus: Petromyzon
Species: marinus

B. Superclass: Pisces (fishes) or Gnathostomata
Class: Condrighthyes
Subclass: Elasmobranshii
Order: Squaliformes
Family: Oxynotidae
Genus: Squalus
Species: acanthias

Transparency Master #3

A. Superclass: Gnathostomata
Class: Osteichthyes
Subclass: Sacropterygii
Order: Crossopterygii
Suborder: Coelacanths
Family: Coelacanthidae
Genus: Latimeria
Species: chalumnae

B. Superclass: Gnathostomata
Class: Osteichthyes
Order: Dipneusti
Family: Ceratodidae
Genus: Neoceratodus
Species: forsteri

Transparency Master #4

A. Superclass: Gnathostomata
Class: Osteichthyes
Subclass: Actinopterygii
Superorder: Chondrostei
Order: Acipenseriformes
Family: Polyodontidae
Genus: Polyodon
Species: spathula

B. Superclass: Gnathostomata
Class: Osteichthyes
Subclass: Actinopterygii
Superorder: Holostei
Order: Amiiformes
Family: Amiidae
Genus: Amia
Species: calva

Transparency Masters # 5 - #10

A. Order: Cypriniformes
Suborder: Cyprinoidei
Family: Cyprinidae
Subfamily: Cyprininae
Genus: Carassius
Species: auratus

B. Order: Cypriniformes
Suborder: Cyprinoidei
Family: Cyprinidae
Subfamily: Cyprininae
Genus: Cyprinnus
Species: carpio

Transparency Master #5

Superclass: Gnathostomata
Class: Osteichthyes
Subclass: Actinopterygii
Superorder: Teleostei

Transparency Master #6

A. Order: Salmoniformes
Family: Salmonidae
Subfamily: Salmoninae
Genus: Oncorhynchus
Species: mykiss

B. Order: Salmoniformes
  Family: Salmonidae
    Subfamily: Salmoninae
      Genus: Oncorhynchus
        Species: kisutch

Transparency Master #7

A. Order: Salmoniformes
  Family: Esocidae
    Genus: Esox
      Species: lucius

B. Order: Perciformes
  Suborder: Percoidai
    Family: Cichlidae
      Genus: Tilapia
        Species: varied

Transparency Master #8

A. Order: Perciformes
  Suborder: Percoidai
    Family: Serranidae
      Genus: Morone
        Species: Saxatilis

B. Order: Siluriformes
  Family: Ictaluridae
    Genus: Ictalurus
      Species: Punctatus

Transparency Master #9

A. Order: Perciformes
  Suborder: Percoidei
    Family: Centrarchidae
      Genus: Micropterus
        Species: salmoides

B. Order: Perciformes
  Suborder: Percoidei
    Family: Centrarchidae
      Genus: Lepomis
        Species: macrochirus

Transparency Master #10

A. Order: Perciformes
  Suborder: Percoidei
    Family: Percidae
      Genus: Perca
        Species: flavescens

B. Order: Perciformes
  Suborder: Percoidei
    Family: Percidae
      Genus: Stizostedion
        Species: vitreum

***Classifications after Gzimek and Nelson**

STUDENT ACTIVITIES

STUDENT WORKSHEET #1 — Specimen Preservation

For additional activities, teachers may refer to the "Suggested Teaching Activities and Procedures" section in the Instructor's Guide.

STUDENT WORKSHEET #1

Specimen Preservation

Purpose:

1. To recognize various preservation methods.
2. To select the proper preservation method for the use intended.
3. To calculate the proper mixture of chemicals for preservative solutions.

Materials:

1. Specimen to be preserved
2. Ethyl alcohol
3. Storage vessel

Procedure:

1. Select the container needed to hold the specimen.

2. Calculate the amount of water to add to make a 70% solution. Use the following equation:

$$\frac{\text{Desired concentration x Desired volume}}{\text{Concentration of stock solution}} = \text{Volume of stock solution to be diluted to desired volume}$$

3. Use the appropriate measuring instrument and prepare enough solution to cover the specimen in the jar.

4. Place lid or covering on the container.

5. Prepare a label with the common name and the genus and species name for the container. Attach to jar.

Questions:

1. What other methods of preservation are available?

2. What are advantages and disadvantages of each method?

STUDENT WORKSHEET #1 — Discussion Guide

It is often necessary to preserve biological materials that are caught or found in the field. Whether the need is for further study and comparison or simply to advance one's personal collection, a knowledge of the common preservation methods is useful.

Methods Used:

1. *Fresh Specimens* — Placing a fresh specimen in a watertight container and packing in a second container of natural or dry ice will normally provide sufficient time for laboratory examination. Outside containers should be waterproof. If natural or dry ice is used, the container should be vented to prevent sublimation explosions.
2. *Refrigeration* — This is an excellent short-term preservation method.
3. *Freezing* — This is an easy method for long-term preservation. Freezing for only a few days requires no special preparation. Longer periods require covering or placing in air-tight containers to prevent moisture loss. It is recommended that separate storage of food items be maintained. A temperature of 0°F is best for specimen maintenance.
4. *Chemicals* — Preservation by chemicals provides for long-term and repeated use of the specimen. Chemicals such as formaldehyde, ethyl alcohol, and borax can be used, or commercial preparations can be purchased that require no mixing (Carolina Biological and Nasco are two sources). Liquid preservatives are nearly always preferable because of the more thorough penetration into tissues. The list of preservatives provided for various materials is offered only as an example. Formaldehyde has lost favor because of the smell and medical implications for users.

Sample Concentration Problem:

If the stock solution is 95% ethyl alcohol (methyl alcohol is not acceptable) the following will provide 300 ml of a 70% solution:

$$\frac{70\% \times 300 \text{ ml}}{95\%} = 221 \text{ ml of } 95\%$$

300 ml desired
- 221 ml 95% alcohol
79 ml of water added to make a 300 ml solution

Materials:

Commercial flint glass or polypropylene wide mouth specimen jars are available from numerous sources. Also, wide mouth canning jars are an acceptable substitute and are readily available.

441

Preservative Recommendations

Biological Material	Recommended techniques, listed in order of preference*
Mammals	
Whole, small	Ethyl alcohol (70%) or 5% formalin (formaldehyde)
Whole, large	Formalin (7-10%); also injection of preservative into internal organs by hypodermic-perfusion via circulatory route
Skins, pelts	(1) Clean thoroughly and air dry; (2) and salt thoroughly (NaCl); (3) use alum on pelts which appear to be "slipping"
Skins, study	(1) Borax (not to be used on skins having red pelage); (2) arsenic trioxide-borax mixture in equal proportions; (3) arsenical soap
Food material stomachs	Small stomachs-5% formalin; large stomachs-5-10% formalin (wrap stomachs in cheesecloth)
Droppings	Dry quickly, fumigate with carbon disulfide
Reproductive tracts	(1) AFA (preferably) or Bouin's fluid; (2) 10% formalin
Birds	
Whole	(1) 70% alcohol; (2) 5% formalin, both with internal injection
Skins, pelts	(1) Borax; (2) arsenic-borax mixture
Stomachs	5% formalin
Droppings and pellets	Dry quickly and fumigate with carbon disulfide
Reptiles and Amphibians	
Whole	(1) 35-40% isopropyl alcohol or 70% ethyl alcohol; (2) formalin-specimens should be slit or injected
Snake skins	Rolled flat, placed in 70% alcohol
Salamanders	Kill with chloretone or 20% alcohol; harden with 5% formalin and store in 70% alcohol
Amphibian skins (to preserve color)	Kill with ether; skin and place skin in water; float onto cardboard; dry quickly
Fish	(1) 70% alcohol; (2) 10% formalin
Insects	
Hard bodies	Kill with KCN bottle; store dry
Soft bodies	Kill and store in 5% formalin or 10% alcohol
Miscellaneous	
Skeletons-field	(1) Clean thoroughly and dry quickly; treat with arsenical soap for shipment; (2) place in alcohol (formalin, unless neutralized, dissolves calcium of bones)
Skeletons-in laboratory	(1) Boil gently in 3% hydrogen peroxide to remove meat and to bleach bones; degrease in carbon tetrachloride; (2) clean by use of dermestid beetles
Fumigants-for all specimens in pelt, study or standing mount form	Carbon disulfide as gas insecticide to kill insects; paradichloro-benzine as insect deterrent and DDT as insect contact killer

*If commercial preparation used, follow label directions

Adapted from: *Wildlife Conservation and Management Curriculum Guide for Vocational Agriculture/Agribusiness*

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Stocking Fish

RELATED PROBLEM AREAS:

1. Feeding Fish
2. Managing Fish
3. Controlling Wildlife Pests
4. Maintaining Wildlife Habitat
5. Managing Hunting and Fishing Clubs
6. Identifying Careers in Agriculture/Horticulture (Central Core Cluster)
7. Identifying Basic Principles of Animal Science (Central Core Cluster)
8. Meeting the Environmental Requirements of Animals (Agricultural Business Management Cluster)

PREREQUISITE PROBLEM AREA(S):

1. Identifying Alternative Animal Productive Systems: Aquaculture (Agricultural Business and Management Cluster)
2. Classifying Fish

LEVEL: Preparatory

OCCUPATIONAL TASKS ADDRESSED:

Agricultural Resources Cluster

Duty A: Managing the Recreational Facility

1. Requisition materials, supplies, and services
2. Follow work schedule
3. Complete business forms
4. Determine land-use capability
5. Interpret maps, charts, and aerial photographs

Duty B: Applying Laws, Regulations, and Policies

1. Interpret game and wildlife laws
2. Interpret Environmental Protection Agency (EPA) regulations
3. Maintain permits, certificates, and licenses

Duty D: Managing Facility Flora and Fauna

1. Identify plant communities and dominant species within a selected area
2. Identify wildlife species within a selected area

Duty E: Performing General Office Work

1. File materials, such as receipts, letters, documents, specifications, and orders

Duty F: Using Tools, Materials, and Equipment

1. Maintain grounds using power equipment
2. Use hand tools
3. Perform preventative maintenance on tools
4. Perform preventative maintenance on equipment

Duty G: Assembling, Servicing, and Maintaining Equipment and Facilities

1. Follow a facility and grounds maintenance schedule
2. Report facility and grounds maintenance needs
3. Inspect structures and conveniences needing maintenance
4. Inspect water and sewer systems
5. Make electrical repairs
6. Troubleshoot equipment failure
7. Maintain facility drainage ditches
8. Perform preventative and scheduled maintenance activities on grounds and facilities

Duty H: Applying Safety Practices

1. Store flammable and other hazardous materials safely
2. Monitor equipment for safe operation

STATE GOALS FOR LEARNING

In planning the instruction for this problem area, teachers can promote the development of several student learning objectives which are related to the State Goals for Learning in Biological and Physical Sciences and Social Sciences. These objectives are listed on the Learning Assessment Plan forms included on the following page(s). Those learning objectives marked with an asterisk (*) are taken from the sample lists provided by the Illinois State Board of Education.

CORE

Illinois Agricultural Core Curriculum

Agricultural Education 124 Mumford Hall 1301 W. Gregory Drive University of Illinois Urbana, IL 61801

Director: Dale A. Law, Ed.D.
Principal Investigator: Jerry D. Pepple, Ed.D
Research Assistant: Robert E. Petrea

Submission Date ____________
☐ Original submission ☐ Revision
Page ____ of ____

I. LEARNING AREA *(check one)*
☐ Language Arts ☐ Fine Arts
☐ Mathematics ☒ Social Sciences
☐ Sciences ☐ Physical Development/Health

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

(Affix label or complete district information.)

COUNTY	DISTRICT	ESC

District Name

City

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will be able to apply the skills and knowledge gained in the social sciences to decision making in life situations.

Contact Person: ____________
Title: ____________
Phone: ( )

III. LEARNING OBJECTIVES

By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:

III. LEARNING OBJECTIVES	IV. ASSESSMENT A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	V. EXPECTATIONS Percent of Students Expected to Achieve Objective
*1. Understand the knowledge and skills required for success in selected fields of work.					
*2. Recognize that competence in a field of work entails the development of a wide range of skills.					
3. Describe the license and permits required for holding, propagating, and selling aquaculture species.					
4. Relate the environmental requirements of various cultured species with the appropriate facility type.					

ISBE 41-78 (1/88)

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

Submission Date ____________
☐ Original submission ☐ Revision
Page ____ of ____

I. LEARNING AREA *(check one)*
☐ Language Arts ☐ Fine Arts
☐ Mathematics ☒ Social Sciences
☐ Sciences ☐ Physical Development/Health

(Affix label or complete district information.)
COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐
District Name
City

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will have a working knowledge of the social and environmental implications and limitations of technological development.

Contact Person: ____________
Title: ____________
Phone: (   )

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Identify materials that are replacing natural resources.					
*2. Recognize the variety of Illinois' natural areas and relate them to economics and recreation.					
3. Identify and describe the types of facilities available for stocking fish.					
4. Explain the elements involved in the relationship between dissolved oxygen content and stocking rate.					

ISBE 41 78 (1/88)

Submission Date ____________
☐ Original submission ☐ Revision
Page ____ of ____

I. LEARNING AREA *(check one)*
☐ Language Arts
☐ Mathematics
☒ Sciences
☐ Fine Arts
☐ Social Sciences
☐ Physical Development/Health

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

(Affix label or complete district information.)

COUNTY	DISTRICT	ESC

District Name

City

II. STATE GOAL FOR LEARNING
As a result of their schooling, students will have a working knowledge of the concepts and basic vocabulary of biological, physical, and environmental sciences and their application to life and work in contemporary technological society.

Contact Person: ____________
Title: ____________
Phone: ( )

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Recognize that all organisms exhibit responses to stimuli.					
*2. Recognize that the populations of plants and animals change as the environment changes.					
*3. Understand the interactions among populations of plants, herbivores and carnivores.					
4. Define terms integral to stocking fish.					
5. Relate the environmental requirements and various cultured species with the appropriate facility type.					
6. Explain the elements involved in the relationship between dissolved oxygen content and stocking rate.					

ISBE 41-78 (1/88)

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Stocking Fish

STUDENT LEARNING OBJECTIVES

Upon completion of their study of this problem area, students will be able to:

1. Define terms integral to stocking fish.
2. Describe the license and permits required for holding, propagating, and selling aquaculture species.
3. Identify and describe the types of facilities available for stocking fish.
4. Relate the environmental requirements of various cultured species with the appropriate facility type.
5. State the common stocking rates for various common cultured species.
6. Explain the elements involved in the relationship between dissolved oxygen content and stocking rate.

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Stocking Fish

PROBLEMS AND QUESTIONS FOR STUDY **INSTRUCTOR'S NOTES AND REFERENCES**

1. Is aquaculture a part of agriculture?
2. What licenses are required to hold aquaculture species?
3. What state agencies are involved in licenses?
4. May one own any aquaculture species that one wishes?
5. What types of facilities are available in which to stock fish?
6. How are the facilities different?
7. How are the facilities alike?
8. What types of equipment are needed with the different types of facilities?
9. What aquaculture species are commonly cultured?
10. What types of facilities are best suited for the various species?
11. Why is a specific type of facility best suited to a particular species?
12. What is stocking rate?
13. What is the stocking rate for commonly cultured species?
14. Why do stocking rates differ?
15. What is dissolved oxygen?
16. Why is dissolved oxygen necessary?
17. How is dissolved oxygen related to stocking rate?
18. How does one measure dissolved oxygen?

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Stocking Fish

SUGGESTED TEACHING ACTIVITIES AND PROCEDURES

1. Use personnel from the Cooperative Extension Service, the Illinois Department of Agriculture Fisheries Division, the Fisheries Research Laboratory at SIU, and members of the Illinois Aquaculture Industries Association as resources for specific additional information.

2. Coordinate with other life science instructors for use of models, specimens, and equipment.

3. Use chapter two of "The Aquaculture Industry in Illinois" as a reference, in conjunction with Transparency Master #1, on the legislative changes which formally include aquaculture as a part of agriculture. The chapter covers registration, facility requirements, operational requirements, disposal, and water concerns.

4. Utilize Information Sheet #1 as a starting point for leading a discussion on the equipment needed in aquaculture.

5. Utilize Information Sheet #2 as a starting point for leading a discussion on the basic stocking rates of various aquaculture species.

6. Information Sheet #3 provides contact persons knowledgeable in aquaculture. After discussing possible questions, assign students an individual from whom to obtain the answers. Be sure that proper etiquette and format are used on the letters.

7. Invite a representative from a commercial company such as Agri-Cover Ltd., to address the class on products of the company. This company produces a complete two-tank aquaculture fish system with all necessary equipment to produce approximately 100 fish. This type of setup may provide a way to become involved in intensive aquaculture. See reference list for complete address.

8. Assign to individual students the task of writing the companies listed in the references requesting a current catalog, to be used as references in conjunction with Information Sheet #1.

9. Obtain a test kit from a local source or one of the companies listed in the references. This kit can be used on local impoundments for practice in determining water quality and as a way to demonstrate to students the variations found within a small geographic area.

10. Use local impoundments such as ponds and reservoirs as target sites for student practice in determining the volume of water present and the number of a given species that could be stocked in that body of water. Use the problem area *Applying Mathematic Skills in Agriculture* as a reference for conversion tables.

11. A small-scale intensive aquaculture system is an aquarium. Two fish tanks of the same size can be set up with differing numbers of the same species fish. A test kit can be used to demonstrate to students the stocking rates effect on the various water quality factors. An alternative would be to stock different species at the same rate and use the test kit to demonstrate differences in water quality.

12. Another use of fish tanks would be to collect information on the number of fish a particular size tank will hold, and use that number as a starting point to calculate the approximate number of fish that could be stocked in various-size larger tanks and outdoor impoundments. Use Student Worksheet #1 as an activity in researching information on a specific species, and in calculating stocking rates.

13. Conduct a field trip to a producer of aquaculture species. Use Information Sheet #3 as a reference for possible field trip sites.

14. Use the Transparency Master Discussion Guide for background information on the transparencies and for points of discussion.

15. Use this problem area in conjunction with problem areas *Feeding Fish* and *Managing Fish*. The content has been broken down for ease of delivery,

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Stocking Fish

SUGGESTED TEACHING ACTIVITIES AND PROCEDURES (con't.)	INSTRUCTOR'S NOTES AND REFERENCES
but all three must be viewed in the context of a whole and actions in one will affect the other two.	
16. Use the text "Specialty Animal Production Curriculum Guide for Vocational Agriculture/ Agribusiness (Bulletin #1806)" for information on raising crawfish, bees, crickets, worms, and bobwhite quail as possible class activities.	

454

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Stocking Fish

REFERENCES

*1. *Third Report to the Fish Farmers.* (1984). Dupree, H.K., Humer J.V., ed. U.S. Fish and Wildlife Service, Fish Farming Experimental Station, P.O. Box 869, Highway 130E, Stuttgart, AR 72160.

*2. *Fish Farming Techniques.* (1987). Belusz, Larry. Instructional Materials Laboratory, #10 Industrial Education Building, 6th and Stewart Rd., Columbia, MO 65211. (314) 882-2883.

*3. *The Aquaculture Industry in Illinois.* (1989). Waite, S.W., Waite, J.L. 1906 Hemlock Dr., Champaign, IL 61821. (217) 351-4108.

4. *Fish Hatchery Management.* (1982). Piper, R.G., McElwain, I.B., Orme, L.E., McCraren, J.P., Fowler, L.G., Leonard, J.R. U.S. Department of the Interior, Fish and Wildlife Service, Washington, DC.

5. *Fish Farming Handbook.* (1980). Brown, E.E., Gratzek, J.B. AVI Publishing Co., Inc., Division of Van Nostrand Reinhold, 115 Fifth Avenue, New York, NY 10003-1004. (212) 254-3232.

6. *Introduction to Fish Physiology.* (1982). Smith, L.S. T.F.H. Publications, Inc., 211 W. Sylvania Ave., P.O. Box 427, Nepture, NJ 07753.

7. *Water Re-Use Systems.* Rosati, Ronald. (Presented at the 1990 Illinois Aquaculture Industry Association Convention, January 9, 1990, Decatur, IL.) Department of Agriculture, Illinois State University.

8. *Specialty Animal Production Curriculum Guide for Vocational Agriculture/Agribusiness (Bulletin #1806).* Department of Education, Office of Vocational Education, Box 94064, Baton Rouge, LA 70804-9064.

Catalogs:

9. Argent Aquaculture. 8702 152nd Ave., N.E., Redmond, WA 98052.

10. Aquatic Eco. Systems, Inc. 2056 Apopka Blvd., Apopka, FL 32703.

11. Cascade Technologies, Inc. T-16 Research Park, Columbia, MO 65211. (314) 882-9943.

12. Agri-Covers Ltd. 320 W. Gridley Rd., Gridley, IL 61744. (309) 747-2152.

*Indicates highly recommended reference

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTIONAL RESOURCES

These resources are intended for use by teachers in planning and teaching the materials for this problem area and may be adapted to fit the teaching method(s) used.

INFORMATION SHEET #1 — Materials, Supplies, Equipment, and Services Needed by and Available to the Aquaculture Industry

INFORMATION SHEET #2 — Stocking Rates

INFORMATION SHEET #3 — Contact Persons for Aquaculture Information

INFORMATION SHEET #4 — Fish Stocking in Ponds for Sport Fishing

TRANSPARENCY MASTER #1 — Sample Application for Aquaculture Permit (with discussion guide)

TRANSPARENCY MASTER #2 — Illinois Agencies Involved in Agriculture (with discussion guide)

TRANSPARENCY MASTER #3 — Facility Types (with discussion guide)

TRANSPARENCY MASTER #4 — Facility Types (with discussion guide)

TRANSPARENCY MASTER #5 — Aquaculture Equipment (with discussion guide)

TRANSPARENCY MASTER #6 — Aquaculture Equipment (with discussion guide)

TRANSPARENCY MASTER #7 — Aquaculture Equipment (with discussion guide)

TRANSPARENCY MASTER #8 — Aquaculture Equipment (with discussion guide)

TRANSPARENCY MASTER #9 — Oxygen (with discussion guide)

TRANSPARENCY MASTER #10 — Oxygen (with discussion guide)

INFORMATION SHEET #1

Materials, Supplies, Equipment, and Services Needed by and Available to the Aquaculture Industry

The following list provides an idea of the requirements that are needed within the aquaculture industry. Many of the items will appear familiar to those acquainted with traditional production agriculture. It must be remembered that the aquaculture industry deals with an environment unlike our own. For instance, the pressure change that a fish encounters within a four foot deep pond is the same as we encounter with a one-mile rise in elevation. This difference, in addition to others peculiar to an aqueous environment, will need to be studied by anyone attempting to be involved in aquaculture.

Though the aquaculture industry in Illinois is relatively young, much work has been done in other areas and many commercial companies exist to supply the products and expertise needed by culturists. See Information Sheet #3 for contact persons who can direct you to sources of products and information.

Materials and Supplies

- Feeds
- Feed additives and vitamins
- Antibiotics, medications, and vaccines
- Defoaming agents
- Pesticides
- Sterilants
- Hormones
- Synthetic salts
- Gaseous and liquid oxygen
- Laboratory supplies
- Plastic bags, boxes, and bins
- Informational, education, and research publications and books
- Rope, screen, and shade cloth
- Outerwear, waders, gloves, boots, coats, and pants
- Paper cartons and packaging materials

Equipment

- Anchors and mooring equipment
- Aerators, agitators, blowers, compressors, paddlewheels, and oxygen-generators
- Air and oxygen diffusers
- Ozone generators
- Aquariums
- Cages and pens
- Electronic controllers, monitors, and recorders
- Boats
- Cleaning and disinfecting equipment
- Computer software and hardware
- Conveyors
- Dip nets, seines, and fish-harvesting equipment
- Energy conservation equipment and electric generators
- Feed manufacturing equipment
- Feeders and timers
- Filtration equipment
- Fish-processing equipment and smokers
- Graders
- Hatchery equipment
- Heaters
- Ice-making and storage equipment
- Laboratory equipment
- Packaging machines
- Pipe and tubing
- Pond liners
- Air and water pumps
- Raceways, tanks, and troughs
- Refrigeration equipment
- Scales and balances
- Sterilizers and water purification equipment
- Fish traps
- Water quality analyzing equipment and test kits

Services

- Analytical chemistry
- Aquaculture consultants
- Aquaculture investment and financial planning
- Computer services
- Contractual research and development
- Convention planning
- Diagnostic services
- Disease certification
- Electrofishing
- Energy conservation
- Engineering services
- Environmental testing
- Exporters
- Feasibility studies
- Feed formulation
- Filtration
- Processors
- Systems design and construction
- Insurance and risk management
- Transportation services

Adapted from *The Aquaculture Industry in Illinois*

INFORMATION SHEET #2

Stocking Rates

The rate at which a particular species may be stocked is dependent on many factors. The stocking rates given are to be used only as a guide. Most references assume that the ponds used are for the express purpose of raising one or more particular species, and appropriate management will be given. A main consideration is the type of facility used. For example, catfish may be stocked at 400 fingerlings per acre with bass and bluegill. However, if cages are used in an established pond, the recommendation is between 6 and 12 catfish per cubic foot of cage volume. This means up to 300 catfish can be added to the pond (if other criteria are met). Intensive practices are still defining rates, with tilapia being stocked at up to one fish per gallon of water.

Stocking Rates

Species	Combination	Largemouth Bass and Hybrid Bluegill Only	Channel Catfish Only
Largemouth Bass	100	200	-
Hybrid Bluegill	600	1000	-
Channel Catfish	400	-	700
Black Crappie*	50	-	-
Fathead Minnows/Lbs**	8	16	8
The above rates for bass, bluegill, and catfish can be at least tripled by high levels of management of water quality and feed. For example:			
Largemouth Bass	500	600	-
Hybrid Bluegill	2500	3000	-
Channel Catfish	1000	-	4000

* Minimum two-acre pond

** Provide a forage base

Tilapia
Fingerlings: 500-1,500/acre

Paddlefish
Fry: 2,000/acre
With catfish: 500 lbs/acre

Big Head Buffalo
1.5-inch fry — 2,000/acre (will reach 7-8 inches)
10,000/acre (will reach 4 inches)

Golden Shiner
Extensive: 2,000 adults/acre
Intensive: 50,000-200,000 fry/acre

Flathead Minnow
Adults: 500-2,000/acre
Fry: 100,000/acre

Goldfish
Adults: 100-300/acre
Fry: 200,000-1,000,000/acre

Striped Bass
1- to 2-inch fingerlings: 10,000-25,000/acre

INFORMATION SHEET #3

Contact Persons for Aquaculture Information

People to Contact:

Dan Selock
Aquaculture Technology Transfer Specialist
Fisheries Research Laboratory
Southern Illinois University
Carbondale, IL 62901-6511
(618) 453-6025
FAX (618) 536-7761

Delayne Holsapple
Illinois Department of Agriculture
State Fairgrounds, P.O. Box 19281
Springfield, IL 62794-9281
(217) 782-6675

Roy Heidinger, Director
Chris Kohler, Bob Sheehan
Fisheries Research Laboratory
Southern Illinois University
Carbondale, IL 62901-6511

LaDon Swann
Aquaculture Extension Specialist
Illinois-Indiana Sea Grant
Purdue University
Department of Animal Sciences
West Lafayette, IN 47907
(317) 494-6264
FAX (317) 494-0409

Ronald Rosati, Associate Professor
Director of Water Reuse Systems
for Aquaculture Research
Department of Agriculture
Illinois State University
Normal, IL 61761

Aquaculture License and Permit Information:

Rodney Horner
Jake Wolf Memorial Fish Hatchery
P.O. Box 560
Manito, IL 61546
(309) 968-7531

Illinois Aquaculture Industry Association:
625 South Second St.
Springfield, IL 62704
(217) 528-5230

Board of Directors:

Peter Reiff
President and Secretary
Logan Hollow Fish Farm
R.R. 1, Box 88A
Rockwood, IL 62280
(618) 763-4266

Sam Pastrovich, Jr.,
Vice President
Pastrovich Live Fish Hauling
R.R. 2, Box 139
Litchfield, IL 62056
(217) 999-7452

Billy Veath, Treasurer
Seven Springs Fish Hatchery
R.R. 1, Box 80
Evansville, IL 62242
(618) 853-2280

Thomas Carver
Carver's Wholesale Bait
and Tackle
R.R. 2, Box 92
Monmouth, IL 61462
(309) 734-7249

Thomas Donahue
Frank's Wholesale Bait
and Tackle
R.R. 1, Box 343
Beecher, IL 60401
(708) 946-2426

Bruce Kinnett
625 S. Second St.
Springfield, IL 62704
(217) 789-6252
(217) 793-0671

Carl Krusa
R.R. 1, Box 154
Bluffs, IL 62621
(217) 754-3995

Gary Marincic
Christian Fisheries
R.R. 1
Oglesby, IL 61348
(815) 223-6728

Andy Roberts
R.R. 1
Virden, IL 62690

Dan Selock
R.R. 4, Box 10
Marion, IL 62959
(618) 453-6025
(618) 997-9279

Stephen Waite
Aquaculture Resources
Midwest
1906 Hemlock Dr.
Champaign, IL 61821
(217) 351-4108
(217) 987-6581

Governmental Agencies:

Illinois Department of Agriculture
Illinois State Fairgrounds
Springfield, IL 62706
(217) 782-2172
Aquaculture Coordinator — (217) 782-4583
Meat, Poultry, and Livestock Inspection — (217) 782-4944
Pesticide Regulations — (217) 785-8251
Natural Resources — (217) 785-1081

Illinois Department of Conservation
Lincoln Tower Plaza
524 S. Second St.
Springfield, IL 62706
(217) 782-6302
Division of Fisheries — (217) 782-6424
Law Enforcement — (217) 782-6431
Permitting and Licensing — (217) 782-2964

Illinois Environmental Protection Agency
2200 Churchill Rd.
Springfield, IL 62706
(217) 782-3397
Agriculture Advisor — (217) 782-3397
NPDES Permits — (217) 782-0610

Illinois Department of Transportation
2300 S. Dirksen Parkway
Springfield, IL 62764
(217) 782-5597
Water Resources — (217) 782-0690
Dam Safety Inspection — (217) 782-3863

Illinois Department of Public Health
535 W. Jefferson, Fl. 3
Springfield, IL 62762
(217) 782-4977

Other Agencies:

Illinois Department of Commerce & Community Affairs
620 E. Second St.
Springfield, IL 62701
(217) 785-1032
Small Business Development Center Hotline — (217) 785-1032
SBA Publications — (800) 368-5855

Illinois Department of Energy & Natural Resources
325 W. Adams St.
Springfield, IL 62706
(217) 785-2002
Alternative Energy — (217) 785-5222
Illinois Natural History Survey — (217) 333-6880
Illinois State Water Survey — (217) 333-2211
Illinois Geological Survey — (217) 333-4747

Illinois Farm Development Authority
427 E. Monroe #210
Springfield, IL 62701
(217) 782-5792

Illinois Department of Mines & Minerals
William G. Stratton Building #704
Springfield, IL 62706
(217) 782-6791

Other Resources

The North Central Regional Aquaculture Center
College of Agriculture and Natural Resources
Department of Fisheries and Wildlife
Michigan State University
East Lansing, MI 48824

Information on this Center is available through the local cooperative extension office.

National Agricultural Library
Aquaculture Information Center
Room 304
Beltsville, MD 20705
(301) 344-3704

This library is the U.S. Center for agricultural information. The Aquaculture Information Center can provide information concerning articles and books currently available, reference services of documents not locally available, and delivery of documents or photocopies of articles to your local library.

Rhode Island Sea Grant
University of Rhode Island, Bay Campus
Narragansett, RI 02882-1197

Write or call for a publications catalog. Available are fact sheets, single page information on aquaculture topics such as brine shrimp or phytoplankton.

Commercial Curriculum Materials

The Mid-America Vocational Curriculum Consortium
1500 W. Seventh Avenue
Stillwater, OK 74074
(405) 377-2000

This company publishes *Aquaculture*, a 15-unit text on all aspects of aquaculture from technical information to marketing and financial planning.

Kendall Hunt Publishing Company
2460 Kerper Boulevard
Box 539
Dubuque, IA 52001
(800)338-5578

This company publishes *Aquatic Resources Education Curriculum*, a text containing a 28-lesson instructor's manual on fish behavior, fishing equipment, conservation and management fish biology, aquatic communities, water as an environment, and other topics.

National 4-H Supply Service
7100 Connecticut Avenue
Chevy Chase, MD 20815
(301) 961-2934

This company publishes *The Aquatic Maestro*, a leader's guide, 5 videos, and a student manual on the setup and use of an aquarium.

Publications Distribution Center
IFAS Building 664
University of Florida
Gainesville, FL 32911
c/o C.M. Hinton

This company publishes *Aquaculture and the Aquarium (Circular 848)*, a 4-H member project booklet that contains information on aquarium equipment, plants, fish and fish maintenance. Included are logs and report pages.

461

INFORMATION SHEET #4

Fish Stocking in Ponds for Sport Fishing

Ponds in Illinois vary greatly in their fish-stocking needs. The owners, managers, and users of these ponds also differ in their sport fishing objectives, and require a wide selection of stocking options. Therefore, it is important to discuss pond stocking with the District Fisheries Biologist.

Most Illinois ponds provide habitat that is suited for "warmwater" fish. The warmwater fish species that are stocked with success are the largemouth bass, bluegill, redear and channel catfish. The stocking of "cool" and "coldwater" fish as an addition to the basic fish stocking, under the proper conditions and timing, also produces good fishing.

Before the fish-stocking decision is made, careful analyses of pond characteristics and angler preferences must be made. Some of the factors affecting the decision include pond type, size, depth, water chemistry, fertility, existing fish population, expected fishing pressure and harvest, and most important, what fish do the fishermen want? Surveys by the Division of Fisheries reveal that the largemouth bass, channel catfish, black and white crappie, bluegill, and redear sunfish are the most fished-for species in the State of Illinois.

The most widely used and successful stocking combination for ponds in Illinois is largemouth bass, channel catfish, bluegill, and redear. These species are popular among fishermen, and are biologically adapted to a wide variety of pond conditions. These species effectively utilize natural and artificial foods, and are compatible with many other species that might be stocked later. The concept of this stocking combination is that the bluegill eat small aquatic insects and in turn serve as food for bass. The bass control the numbers of small fish so that those remaining grow to large size.

Some pond owners are reluctant to stock bluegill because of their reputation for overpopulating. The cause for most bluegill problems is traceable to overharvest of largemouth bass and not to the bluegill themselves. Redear sunfish, in limited situations, are substituted for the bluegill. In most cases, they are generally stocked in combination with the bluegill at a ratio of 70 percent bluegill to 30 percent redear. The redear is a southern species and generally doesn't survive the winter, north of Interstate 80. Bass and bluegill are sometimes stocked alone if redear and channel catfish are not desired.

Fingerling fish (one to three inches) are recommended for the initial stocking of new or rehabilitated ponds. It is essential that no fish life exist in the pond before the initial stocking. An exception to this rule might be early stocking of breeder sized fathead minnows (two inch). These minnows create an abundant food supply.

The recommended initial stocking rate varies for different fish species. It is very important that the proper number of fish be stocked, since this original stocking must support the first four to five years of fishing.

Fertility Map of Illinois Impoundments Based on Alkalinity of the Water

Alkalinity	Fertility Rating	Fertility Key	Approximate Carrying Capacity (Lbs/Acre) LM Bass	Bluegill
> 100 ppm*	Good	▒	100	400
50 to 100 ppm*	Average	▨	50	200
< 50 ppm*	Fair		25	75

*Parts per million

Locate your pond in the black, crosshatched, or clear areas in the preceding map. Use the following chart as a guide for its initial stocking.

Initial Fish Stocking Guide

Fertility Key	▒	▒	▒	▨	▨	▨			
Soil Type of Pond	Black	Light	Forest	Black	Light	Forest	Black	Light	Forest
Number of fingerling fish stocked per surface acre									
Largemouth Bass	100	80	60	90	70	50	80	60	40
Channel Catfish	100	80	60	90	70	50	80	60	40
Bluegill	1000	700	500	800	600	400	700	500	300
Bluegill/Redear Combination									
Bluegill	700	560	490	490	420	350	350	310	245
Redear	300	240	210	210	180	150	150	140	105

The above pond-stocking guide is based on the utilization of natural food and does not consider artificial feeding which can potentially increase the stocking rates. By initially stocking the correct numbers of fingerlings, a pond or lake will produce sport fishing in less time than by releasing smaller numbers of adult fish. Stocking a few adult fish in a new pond results in an excessive first spawn and stunted fish. If properly managed, bass, bluegill, and redear need only an initial stocking as their natural spawning success is adequate to maintain sufficient numbers. Channel catfish do not normally maintain a population by natural reproduction in ponds in the presence of bass and bluegill. Therefore, supplemental stocking must be completed to sustain a fishable channel catfish population.

After the initial stocking, there are numerous other fish-stocking situations that may be used to develop or maintain a sport fishery. However, these more complex stocking options should only be pursued under the supervision of a fisheries biologist. Some of these stocking options and examples of them are as follows:

1. Corrective stocking — Restoring balance to "unbalanced" fish populations requires the partial removal of the stunted fish and a corrective stocking of either the predator or prey species. Impoundments with a stunted seven- to eleven-inch bass population require the stocking of several hundred adult bluegill per acre, while with a stunted three- to five-inch bluegill population, a stocking of 100 eight- to ten-inch bass per acre is required. Corrective stocking is an effective fishery management tool when applied under the proper situation.

2. Diversification stocking — Many different physical, chemical, and biological conditions occur within Illinois ponds. It is usually possible to stock additional fish species to diversify the sport fishery. Most of these newly stocked species compete with the existing fish population for food and space. This decreases the numbers and total weight of the existing population. Examples of this type of stocking might include eight-inch walleye stocked at five per acre, eight- to ten-inch muskellunge stocked at one per acre, or six-inch hybrid striped bass stocked at three to five per acre. Maintenance of these non-recruiting populations requires periodic supplemental stockings of nonvulnerable-sized fish.

3. Food chain utilization stocking — Illinois ponds have complex food chains which serve a variety of fish species. In many ponds, parts of this food chain are not used because certain fish are absent. Adult redear sunfish, for example, eat freshwater snails, and in many ponds having an abundance of snails, the introduction of redear sunfish improves the utilization of an existing food source. This type of stocking situation requires releasing up to 100 or more adult fish per acre.

4. Food chain improvement stocking — This type of stocking is done in an attempt to improve the production of an existing or future fish population by increasing and diversifying the food chain. In some cases the initial growth of bass in a new stocking is doubled by the earlier introduction of two pounds of fathead minnows per acre. Threadfin shad are also used with some success in large impoundments to provide an increased forage base for the larger predator fish. Threadfin shad however, will not overwinter in most ponds in Illinois where winter water temperatures dip below 45° F for an extended period of time. The stocking of other forage fish, freshwater shrimp, and other invertebrates is also successful in food-chain improvement.

5. Hybrid sunfish stocking — Hybrid sunfish are stocked extensively in small impoundments throughout Illinois. The results of this stocking have been mixed. They are generally stocked with the idea that they do not overpopulate like the bluegill and grow at a much faster rate than other sunfish species.

   Experience with hybrid sunfish revealed several distinct disadvantages. Their major problem is an inability to reproduce to maintain largemouth bass growth. Most waters stocked with a combination of largemouth bass and hybrid sunfish develop a stunted bass population along with a virtual disappearance of the hybrids. To maintain the hybrid sunfish population, they must be restocked periodically at a costly three- to five-inch size.

   The bluegill (male) x green sunfish (female) hybrid is the best choice to stock in small ponds less than one acre where the fish will be artificially fed and the management objective is to produce very large sized panfish. Initial stocking rates for hybrid sunfish vary between 500 and 1,000 fingerling fish per acre. Channel catfish fingerlings, stocked at rates from 100 to 200 per acre, can be included with the hybrid sunfish. In addition, adult fathead minnows can be stocked to provide forage.

   If artificial food is not to be used, a combination of bluegill x green sunfish hybrids and redear x green sunfish hybrids produce the best results. A lower stocking rate is suggested for the non-fed hybrid sunfish populations. As with any hybrid sunfish, a periodic stocking is required to sustain their population. Hybrid sunfish have little or no value when stocked in the presence of existing non-hybrid sunfish populations or in combination with other species.

6. Seasonal trout stocking — Because of the lower water temperatures in warm water impoundments during the fall, winter, and spring seasons, it is possible to stock (ten-inch or larger) rainbow trout for the creation of a unique cold water sport fishery. In Illinois, rainbow trout live in most small impoundments from mid-October to mid-May. The stocking rate for this put-and-take trout fishing program is 100 to 500 per acre depending on the expected amount of fishing pressure.

7. Harvest stocking — This type of stocking is very expensive and is comparable to the hunting club that releases pen-reared game birds in front of the hunter. This technique involves the purchase and stocking of various fish species at a catchable size with the expectation that they will be harvested in a very short period. This type of stocking is designed for small ponds that receive heavy fishing pressure.

Pond Fish and Fishing in Illinois, Department of Conservation

464

TRANSPARENCY MASTER #1

Sample Application for Aquaculture Permit

State of Illinois
Department of Conservation

Application for Aquaculture Permit ($50.00)
For Assistance call (309) 968-7531

Date ______________

1. Name of Applicant ______________ Date of Birth ______________
Last First Middle (MM/DD/YY)

Home Address ______________
Street City Zip Code County Home Phone

Business Address ______________
Street City Zip Code County Bus. Phone

2. Location of Aquaculture Facility:

Name: ______________

Address: ______________
Street City Zip Code County

Township ______________ Range ______________ ¼ Section ______________

3. Request for a permit to breed, hatch, propagate or raise:

( ) Amphibians ( ) Reptiles ( ) Crustaceans ( ) Mussels ( ) Clams ( ) Gastropods
( ) Fish ( ) Aquatic Plants ( ) Other

4. Please list the species which are on the Aquatic Life Approved Species List that you would like permission to breed, hatch, propagate or raise: ______________

6. Please describe the type of facility where you plan to breed, hatch, propagate or raise these aquatic species (i.e. ponds, outside raceways, inside raceways, inside tanks or trays, etc.): ______________

7. Do you plan to transport or sell the aquatic life alive and/or dead? ______________

8. What types of markets do you plan to sell the aquatic life (i.e. pond stocking, bait dealers, retail food outlets, etc.): ______________

9. Signature of Applicant ______________

Remit by check, draft or money order, payable to the Department of Conservation. The Department will not assume responsibility for cash sent in the mail. The permit will expire on January 31. Mail application and remittance to:

Department of Conservation
Aquaculture Permit
524 S. 2nd St., Room 210
P.O. Box 19458
Springfield, IL 62794-9458

Do Not Use This Space
Approved by ______________ Date ______________
Permit # ______________
Date Issued ______________

This application (or cancelled check) is not a permit and does not entitle a person to operate an aquaculture facility.

IL 422-0699
Revised 18SEP89

TRANSPARENCY MASTER #2

Illinois Agencies Involved in Agriculture

Illinois Department of Agriculture

Illinois Department of Conservation

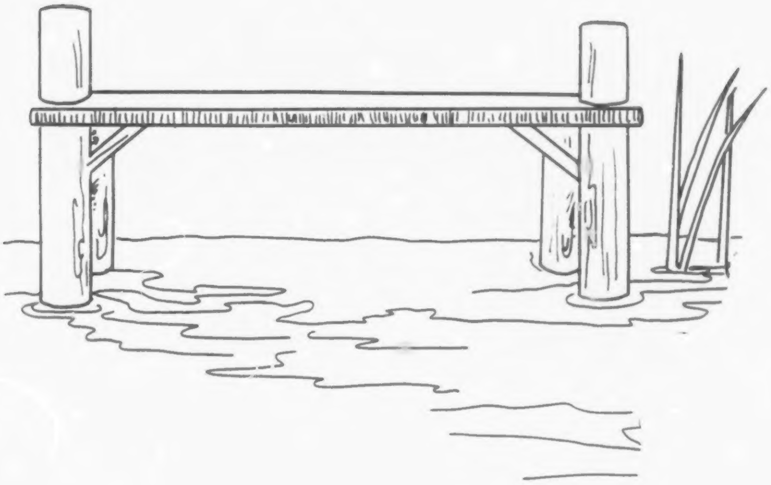
Illinois Environmental Protection Agency

Illinois Department of Transportation

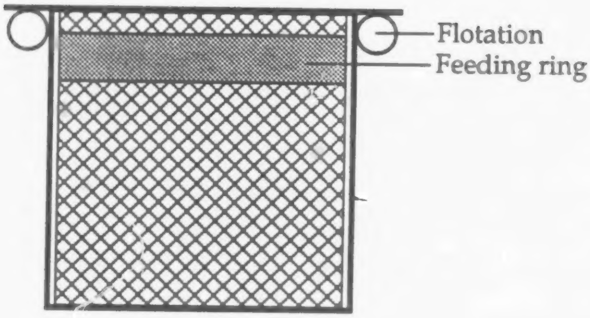
Illinois Department of Public Health

TRANSPARENCY MASTER #3

Facility Types



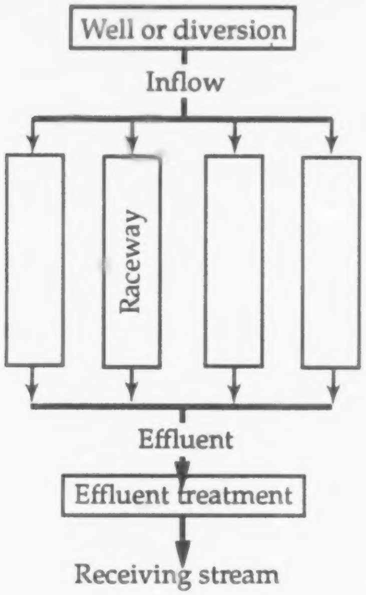
Pond


Flotation
Feeding ring

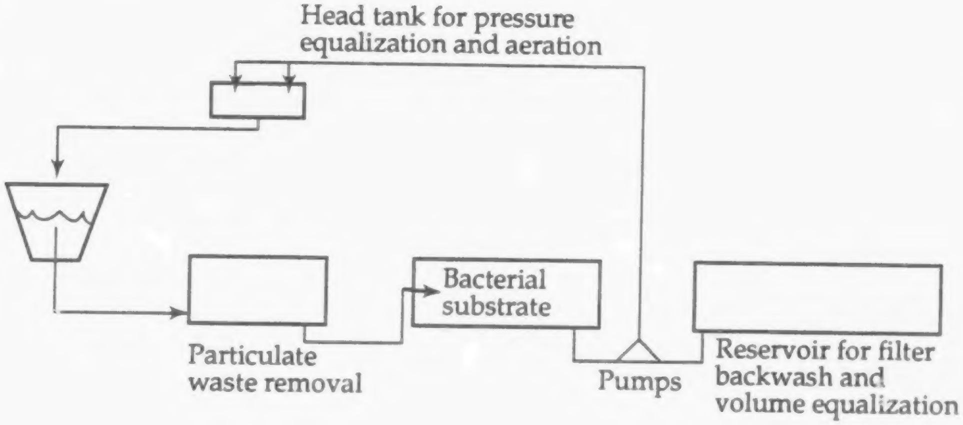
Cage in pond or lake

TRANSPARENCY MASTER #4

Facility Types


Well or diversion
Inflow
Raceway
Effluent
Effluent treatment
Receiving stream

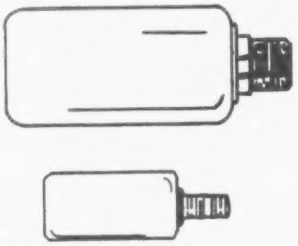
Raceway


Head tank for pressure equalization and aeration
Bacterial substrate
Particulate waste removal
Pumps
Reservoir for filter backwash and volume equalization

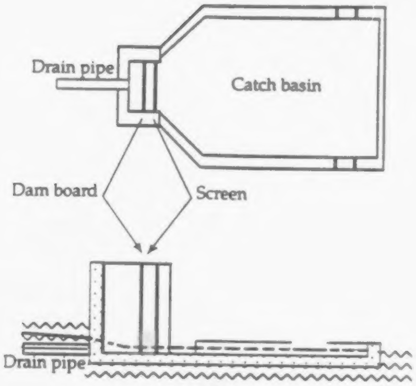
Water Reuse

TRANSPARENCY MASTER #5

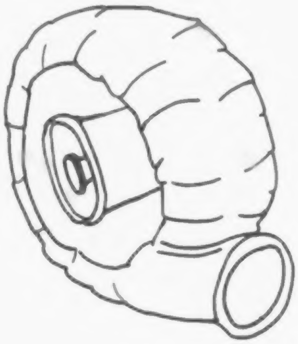
Aquaculture Equipment



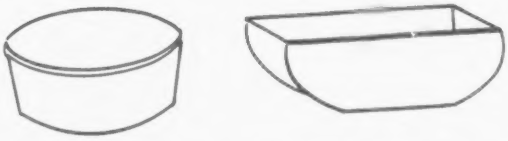
Ceramic air/oxygen diffusers


Drain pipe
Catch basin
Dam board
Screen
Drain pipe

Pond outlet catch basin



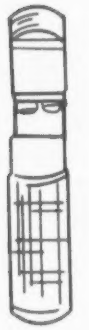
Air blower



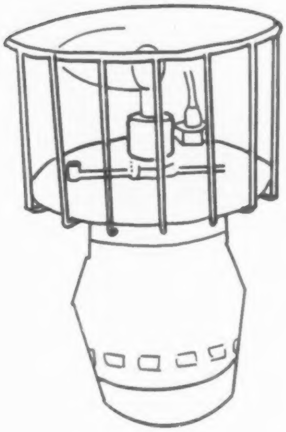
Holding and growing tanks

TRANSPARENCY MASTER #6

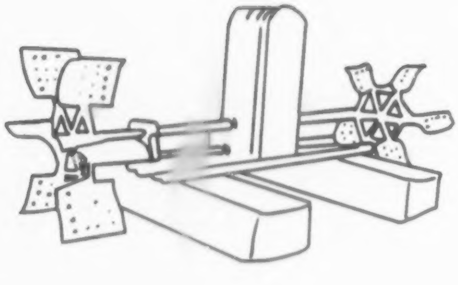
Aquaculture Equipment



Transport agitators



Surface type aerator

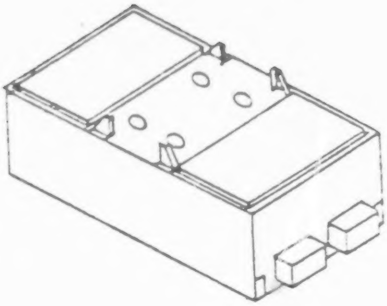


Paddlewheel aerator

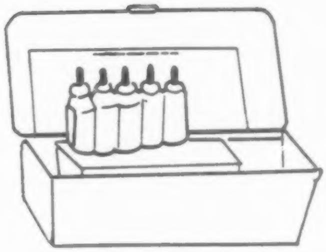
470

TRANSPARENCY MASTER #7

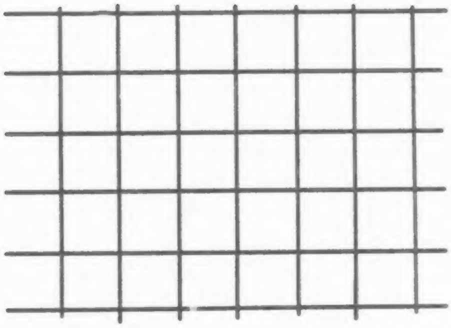
Aquaculture Equipment



Hauling tank



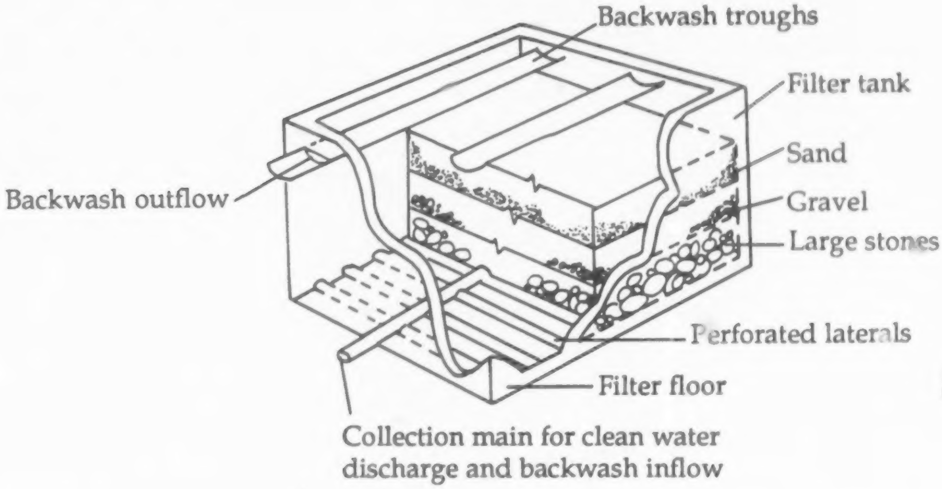
Test kit



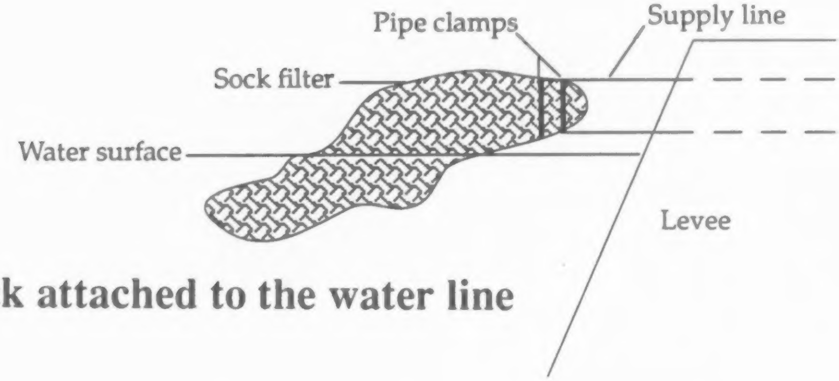
Netting

TRANSPARENCY MASTER #8

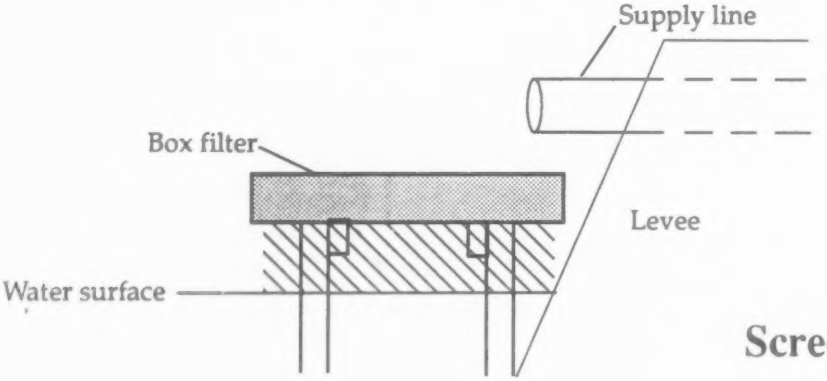
Aquaculture Equipment


Backwash troughs
Filter tank
Sand
Gravel
Large stones
Backwash outflow
Perforated laterals
Filter floor
Collection main for clean water discharge and backwash inflow

Sand Filter


Pipe clamps
Supply line
Sock filter
Water surface
Levee

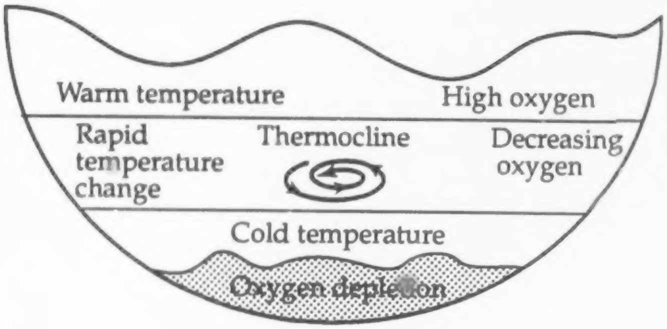
Saran Sock attached to the water line


Supply line
Box filter
Levee
Water surface

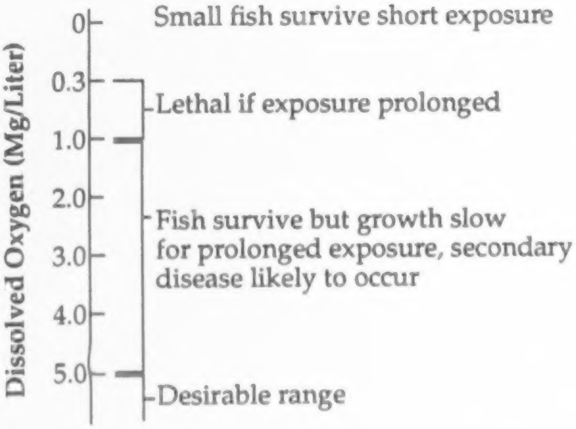
Screen Box Filter

TRANSPARENCY MASTER #9

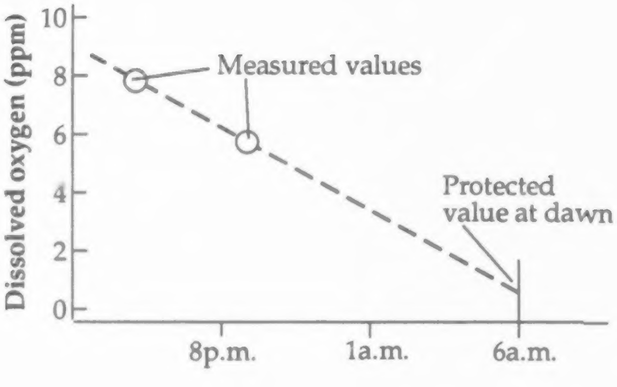
Oxygen


Warm temperature
High oxygen
Rapid temperature change
Thermocline
Decreasing oxygen
Cold temperature
Oxygen depletion

Summer Layering



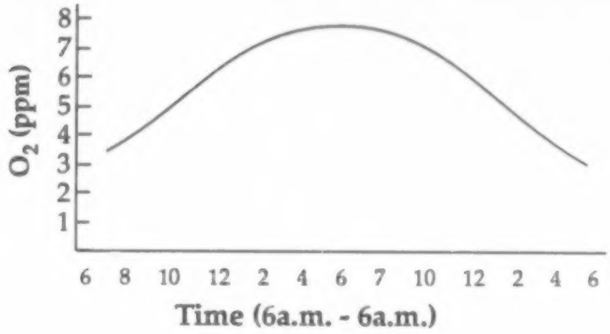
Effects of dissolved oxygen on warm water pond fish. Milligrams/liter = parts per million



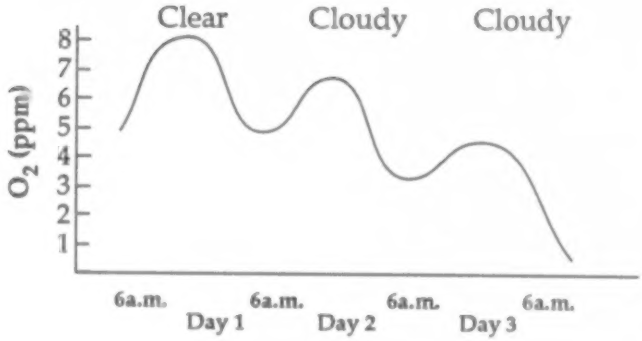
Depletion of O_2

TRANSPARENCY MASTER #10

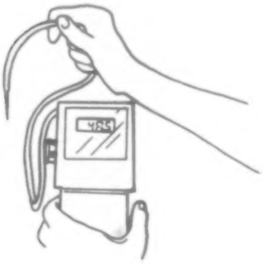
Oxygen



Daily Cycle



Cloudy Weather



O_2 Meter

TRANSPARENCY MASTER DISCUSSION GUIDE

Transparency Master #1

This transparency is a copy of the State of Illinois application to possess aquaculture species. A complete listing of species approved for the purposes of aquaculture can be found on pages 2-25 through 2-29 in *The Aquaculture Industry of Illinois*, or the list may be obtained from the Department of Conservation, 524 S. 2nd St., Room 210, Box 19458, Springfield, IL 62794-9488. The procedure for approval is as follows:

1. Application is obtained from the Illinois Department of Conservation, Permit Section. (217) 782-6424.
2. Return completed application to Department of Conservation at the enclosed address along with the required $50.00 fee.
3. The permit application is sent to the inspection official at the Jake Wolf Memorial Fish Hatchery in Manito, Illinois.
4. If the species you desire is listed in the aquatic life approved species list, that species is listed under #4 on the application. The listed species is checked by the inspection official to see that it is listed on the approved list and approval is given. The application is then sent back to the Department of Conservation office and a permit is issued.
5. If the species you desire is *not* listed in the aquatic life approved species list, that species is listed under #5 on the application. Then:
    a. An inspection of the facilities is scheduled. A review is made of holding facilities, effluent discharge, maintenance and control of possible fry escapement, etc.

    b. If the facility is not constructed, then plans of that facility must be submitted for review of pertinent concerns.

    c. The inspection form, with a recommendation for acceptance or rejection is then taken before the Aquaculture Advisory Committee which advises the state chief of fisheries. The Advisory Committee then recommends to the chief of fisheries whether the permit should or should not be issued.

    d. The chief of fisheries makes the final decision to issue or not to issue the permit.

    e. If the permit is issued, an *Import and Possess Authorization Letter* is issued for that species at that particular facility.

    f. The Import and Possess Authorization letter must be kept with the Aquaculture Permit issued by the Department of Conservation.

    Note: *Each* species not listed on the aquatic life approved species list must have an individual Import and Possess Authorization letter at the facility that it is located.

    g. The Aquaculture Permit and the Import and Possess Authorization letter are annually renewable.

Transparency Master #2

This transparency lists the agencies involved in aquaculture. Below each department is a listing of its function.

Illinois Department of Agriculture

1. Is the principal state agency for developing a program to assist the state's aquaculture industry.
2. Promotes aquaculture in the state.
3. Serves as a clearinghouse for information on aquaculture and provides assistance, information, and data relating to the production and use of aquatic foods, permit and license requirements, and regulations governing the aquaculture industry.
4. Promulgates the necessary rules and regulations to implement the Aquaculture Development Act.
5. Coordinates with other state agencies to promote the maximum flow of information and avoid unnecessary overlapping of regulations.
6. Assists in marketing and promotion of aquatic products.
7. Regulates pesticide use and users.
8. Operates animal disease laboratories for the detection of diseases and toxic substances.

475

Illinois Department of Conservation

1. Enforces provisions of the Fish Code of 1971 protecting aquatic life in the native environment.
2. Issues aquaculture permits and licenses.
3. Regulates importation of non-indigenous aquatic life.
4. Reviews permit applications to conserve and preserve the state's natural and cultural resources.

Illinois Environmental Protection Agency

1. Issues licenses and permits to protect the environment from air, water, and soil pollution violations, including waste-water discharges from aquaculture facilities; disposal of wastes from aquatic facilities; hauling and disposal of waste materials, including dredged materials from construction of dams, ponds, levees, docks or piers, or any other structure in streams, lakes, wetlands, or floodplains for aquaculture production.
2. Monitors and enforces compliance with provisions of the permits and licenses.

Illinois Department of Transportation

1. Regulates waterway activities through issuance of permits to protect public interests from possible adverse effects, including increases in potential flood damage, wrongful use or encroachment, obstruction to navigation, and unnecessary damage to the waterway's natural conditions; this regulation affects the construction of dams, ponds, levees, docks, piers, or any other structure in streams, lakes, wetlands, or floodplains for aquaculture production.

Illinois Department of Public Health

1. Issues guidelines and procedures for processing and storing aquatic products.
2. Enforces the Illinois Food, Drugs, and Cosmetic Act.
3. Conducts sanitary inspections of processing, wholesaling, and retailing establishments.

Transparency Master #3

After the decision to become involved in aquaculture is made, the decision on site selection and system is the next consideration. Factors of suitability include:

1. Water, which is the "bottom line" for any aquaculture operation. Source, quantity, and quality of the water are all extremely important.
2. Land considerations such as location, zoning, access to transportation networks and markets for products, availability of utilities, and security.
3. Status of available facilities; the condition of ponds, buildings, etc.; renovation and maintenance costs, building codes and ordinances; liability and insurability of the facilities.

Associated with the selection of a site is the type of system to be used. The following criteria need to be evaluated:

1. The culture species used; their behavior; their metabolic, temperature, oxygen, and water-quality requirements; their resistance or susceptibility to disease; feed and feeding requirements; and their legal status.
2. Stocking density.
3. Production, harvesting, and marketing schedules.
4. Energy requirements versus availability.
5. Production economics.
6. Maintenance of system.
7. Legal and regulatory requirements.

During the evaluation procedure, the following types of facilities will come under scrutiny:

Ponds

Ponds may be of different types such as:

1. Ravine ponds constructed by damming a ravine or creek.
2. Excavated ponds in which earth is removed to form the desired shape.
3. Levee ponds constructed similar to irrigated rice patties but with higher banks.

Ponds are similar to natural ecosystems and are generally a good combination of productivity and manageability. A useable pond may already be available, which reduces start-up expenses, and in such a pond a basic food system of bacteria and microscopic plants and animals is already present. Using available ponds requiring little start-up expense is most beneficial for extensive, low water exchange and low fish density enterprises. The option of fee fishing may be used in the production economics. Fertilization may enhance phytoplankton production to reduce feed requirements or to increase densities.

Considerations for ponds include:

1. Proper drainage.
2. Freedom from overflow and flooding.
3. Water source.
4. Location proximity to animal waste facilities and crop production chemical runoff.
5. Bottom topography (relevant to harvest method).
6. Soil type.

The ideal pond size is subject to debate. The advantages of small ponds (1 - 5 acres) include:

1. They are easier and quicker to harvest; they also can be drained and refilled quickly.
2. They are easier to treat for disease, to fertilize, etc.
3. Financial loss is minimized if the stock are lost from a pond.
4. Their banks are less subject to wind erosion.
5. They permit segregation of breeders or fish of different sizes and species, resulting in more flexibility within the operation.
6. They permit more simultaneous experimentation.

Advantages of large ponds (5 - 20 acres) include:

1. They cost less to construct per unit production area; less soil must be moved to achieve equivalent surface area.
2. They take up less space per area of production.
3. There is a better potential for wind to naturally aerate the pond.
4. They are more biologically stable (the removal or addition of fish represents a small percentage of the total).

Pond depth is of consideration because shallow areas encourage plant and algae growth. Minimum depth should be 2 ½ to 3 feet. The maximum depth is less important, but usually 4 to 6 feet is the deepest because of cost. Ravine pond depth is dependent on existing topography.

Ponds may, of course, be used under intensive (higher fish densities than can be supported by natural environment; use of formulated feeds and high water exchange rates, or supplemental oxygen source) conditions. The production of a single species or polyculture may produce 3,000 - 5,000 pounds per acre. One of the disadvantages of ponds in Illinois is that many commercial species will not tolerate the climate the year round.

Cage Culture

Cage culture is the use of cages to rear fish in ponds that may be unsuitable for harvest because of bottom topography, brush, flowing waters, or aquatic plants. Advantages include multiple crops (double cropping), ability to observe for disease, and harvesting ease. Disadvantages can be cost of initial construction (dependent on materials), short life expectancy, difficulty in handling, need to provide a complete feed, and potential for theft or vandalism.

Cages depend on natural actions to remove wastes and provide water turnover for oxygen. Ponds should be at least six feet deep, and sufficient room beneath the bottom of the cage is essential for waste removal. A pond size of one acre is thought to be best, with 1/3 acre the minimum.

Transparency Master #4

Raceways

Raceways are an "open" system in that fresh water flows through the facility once and then passes out of the system carrying with it waste products. Although "closed" raceways may be used, the requirements of not only the large amounts of water but also the pumps to return the water to a processing reservoir, make the arrangement uneconomical. Trout has been the traditional species for raceway production, but others are now being cultured in this manner.

Water Reuse Systems

Water reuse systems have proponents within Illinois who cite the use of abandoned hog and poultry facilities as buildings that may be converted to aquaculture production. Advantages include water and heat conservation, environmental and disease control, good stock management, harvesting ease, lengthening the growing system, producing multiple crops, and production of several species. Disadvantages include high outlays of capital, high operating expenses, and high levels of management. In addition, artificial filtration to remove particulate material, and a conversion unit (biological, and some chemical) to transform ammonia (in the water) to nitrite and nitrate so that the water may be reused, are required.

1. Biofilters — In intensive production systems one of the main waste products is ammonia. Ammonia (NH_3) is highly toxic to fish. A mechanism for converting ammonia to nitrate which is relatively harmless, is bypassing the water over an area in which nitrifying bacteria have been cultured. Ammonia is converted to nitrite by *nitrosomonas*. Nitrite, however, is also toxic to fish and a lowering of ammonia will be accompanied by an increase in nitrite. Nitrite is converted to nitrate by *nitrobacter* (the complete nitrification model).

   The principal concern of biofilters is to maintain as steady a cycle as possible. There is a strong tendency toward fluctuations of ammonia level, of *nitrosomonas* conversion of ammonia to nitrite, of nitrite level, of *nitrobacter* conversion of nitrite to nitrate, and of nitrate level. While *nitrosomonas* levels are down, an ammonia rise occurs which may reach toxic levels for fish before the *nitrosomonas* populations increase for conversion. When nitrite levels rise after the conversion, a toxic level for fish may be reached before the *nitrobacter* populations increase to accomplish sufficient conversion of nitrite to nitrate.

   As can be seen, it is difficult to establish and maintain the biofilter cycle. Additionally, the cycle is susceptible to disruption from wide pH fluctuation after establishment. Biofilters may be constructed from gravel, shale, polystyrene beads, plastic rings, fiberglass sheets, and plastic netting. Any substance that the bacteria can attach itself to may be considered. Rotating bacteria contactors (RBC) are available which allow for exposure of the bacteria to air for increased efficiency. Disadvantages include high cost and the fact that filter size and water flow rates must be sized according to need.

Transparency Masters #5, 6, 7, and 8

These four transparency masters show equipment needed for aquaculture operations. The examples are only a sample of that which is available from commercial establishments.

Transparency Master #5

1. Oxygen Diffusers — Used to more thoroughly mix oxygen in the water. Air or oxygen is forced through the pores in the ceramic blocks shown. The size of the pores regulates the size of bubbles; the smaller the bubbles the more efficiently they can be used by fish. Plastic pipe with holes drilled in it or hose with slits cut are other options used as diffusers.

2. Catch Basin — Installed in the drain of a pond to facilitate harvest of fish. As the pond is lowered fish tend to congregate in the deepest water which will be over the basin. Some fish may be stressed by low oxygen during the process.

3. Air Blower — A low pressure blower used to aerate water.

4. Tanks — Can be used for spawning, hatching, holding, or growing depending on the operation. Tanks are used in outdoor and indoor applications. Tanks may be constructed of concrete, concrete blocks, stainless steel, fiberglass, many materials with plastic liners, and others.

   Advantages of round tank:

   a. Better water movement.

   b. Ability to create stream, simulating upstream swimming.

   Advantage of square tank:

   a. Less wasted space.

Transparency Master #6

1. Transport Agitators — Used in transport tanks to aerate the water. A cage around the impeller protects fish. Agitators may be substituted for by a compressed air or oxygen system.

2. Surface Type Aerator — Mounted beneath some type of flotation device with the impeller pointing upward. Water is drawn from beneath and expressed into the air for mixing. Generated currents generally are short. Electricity is required on most models.

3. Paddlewheel Aerator — Mechanically mixes the water with air, setting up currents for drawing water upward. Some models are PTO driven and wheeled for transport.

Transparency Master #7

1. Hauling Tank — Used to transport species from location to location. The top has holes for insertion of agitators or aeration hoses; the bottom is sloped to facilitate removal.

2. Test Kit — Various kits are available for testing water quality, ranging from kits for single-determination tests, to complete analyses. Kits may include colorimeter, manual drop titration, or digital titration. Tests needed include:

   Acidity
   Alkalinity
   Ammonia - N
   Carbon Dioxide
   Chloride
   Dissolved Oxygen
   Hardness
   Nitrite
   pH
   Temperature

3. Netting — May be polypropylene (high or low density) nylon or cord.

Transparency Master #8

1. Sand Filter — Shown in the diagram. The water supply is clarified as it flows down through the sand and gravel bed, and is then collected in the perforated lateral pipes and discharged from the filter. The filter is backwashed to clean it by pumping water up through the gravel and sand; the collected waste material is washed out the backwash outflow.

2. Screen Box Filter

3. Saran Sock Filter — Used on water inlet lines (as is the screen box filter listed above) to remove debris, organisms, and unwanted fish species, particularly if source water is open.

4. Other Types of Filters

   a. Triangle Filter — Contains microscreens that are sized to remove the desired particles.

   b. Gilcil — Contains a centrifugal at the top which forces particles to the side and also contains a sand filter in the lower portion. This filter is very efficient but requires high PSI (40) and 50-60 gal/min to backflush.

   c. Multiflow — Contains a series of sock-type filters through which water flows and in which sediment is collected. Socks may be reusable or disposable.

   d. Vibrating Screen — Contains various sizes of screens which vibrate horizontally to remove particulate matter.

   e. Tube Separators — Contains tubes installed at an angle (45° for instance) in a container. As the water flows upward in the tubes, velocity is lost and particles precipitate. Tube separators produce good results and may be made from plastic pipe that is easily cleaned. Sizing is required to fit need.

Transparency Master #9

Dissolved oxygen (DO) is one of the primary considerations in raising fish. Low dissolved oxygen may be tolerated for a period of time but growth stops and stress-related diseases and parasites increase. Death occurs after extended periods (hours or days depending on species). As an example, man has available 200,000 ppm of O_2 in the air whereas fish have a maximum of 14 ppm and under many instances only half that amount.

1. Summer Layering

   a. Layering is the result of surface water being warmer and thus less dense (above 39°F) than the cooler more dense water below. Dead plants, dead animals, and excretory products sink to the bottom and use up O_2 in their decomposition. The layers prevent mixing by natural actions.

   b. Ask students to describe the difference in "layering" and "spring turnover." In spring turnover the ice melts, water warms on top and becomes more dense than the water below (see item c below). Currents are thus established to mix the warm oxygenated water with the stagnant cooler water below.

   c. Ask students to describe water freezing on a pond. As water cools to 39°F the water becomes more dense. At 39°F it is at its greatest density. As the water cools below 39°F it becomes lighter (less dense) and thus the water freezes from the top down instead of the bottom up.

2. The various dissolved oxygen contents, in ppm, are shown with their common results on fish. The following shows the variations in oxygen saturation levels in various situations.

Oxygen Saturation

a. Temperature — Rise in temperature/fall in saturation level.

b. Salinity — Rise in salinity/fall in saturation level.

c. Barometric pressure — Rise in barometric pressure/fall in saturation level.

d. Elevation — Rise in elevation/fall in saturation level.

At 85°F, 0 ppt salinity, 760 mm Mercury, sea level — 7.5 ppm O_2 (saturation)

At 85°F, 20 ppt salinity, 760 mm Mercury, sea level — 6.7 ppm O_2 (saturation)

At 85°F, 0 ppt salinity, 740 mm Mercury, sea level — 7.3 ppm O_2 (saturation)

At 85°F, 0 ppt salinity, 760 mm Mercury, 4,000 ft. — 6.5 ppm O_2 (saturation)

At 32°F, 0 ppt salinity, 760 mm Mercury, sea level — 14.6 ppm O_2 (saturation)

The following relates water temperature and depth to oxygen content:

Oxygen-Temperature Profile for a Missouri Catfish Production Pond in Mid-Summer (weather: cloudy; time: 9 a.m.)

Depth (feet)	Oxygen (ppm)	Temperature (degrees F)
Surface	7.1	80.6
1	7.0	80.6
2	6.8	79.0
3	6.8	79.0
4	6.8	79.0
5	6.6	79.0
6	5.6	78.0
	Thermocline	
7	1.8	77.0
8	0.3	75.0
9	0.3	70.0
10	0.3	62.6

3. The depletion of oxygen that occurs during the early morning as the result of nighttime plankton respiration is indicated in the chart. The chart shows the estimated drop in O_2 by morning through the extension of a line from two measurements, one at dusk, the other three hours later. The values can be used as guides in deciding if additional aeration is required and in determining an approximation of the time at which it is required.

Production of Dissolved Oxygen

	ppm
Photosynthesis by Phytoplankton	5 - 20
Diffusion from air (calm waters - little moving - moderate)	1 - 5

Loss of Dissolved Oxygen

	ppm
Plankton respiration	5 - 15
Fish respiration	2 - 6
Decomposition in bottom	1 - 3
Diffusion	1 - 5

Other considerations

a. Species — Trout use more O_2 than catfish.

b. Size — Large fish need more O_2 than smaller fish.

c. Food Intake — After feeding, fish require more O_2; don't feed in low O_2 situations.

d. Activity — Active catfish use more O_2 than inactive catfish.

e. Temperature — As temperature goes up, fish require more O_2 (compare this to the saturation level of O_2 in warmer waters — opposite: fish need more, less available).

Transparency Master #10

Additional considerations to oxygen availability:

1. Daily Cycle — Result of photosynthetic production of phytoplankton.

2. Seasonal Cycles

   a. Summer Worst (See Transparency Master #7) — Less O_2 in water, higher fish respiration, stratification, phytoplankton bloom die off and decay.

   b. Winter — Ice prevents photosynthesis and build-up of gases (CO_2, NH_4) occurs.

  c. Spring and Fall — Few O_2 problems.

3. An example of a digital oxygen meter; also available are oxygen kits to test O_2.

4. Additional discussions can be led concerning the following:

Corrective measures include:

1. Motor boat.
2. Paddle wheel.
3. Pumps and others.
4. Chemical (potassium permanganate, super phosphate).
5. Caution in not stirring up pond bottoms if septic conditions exist. Black bottom muds usually should not be disturbed.

Preventive measures include:

1. Supplemental aeration.
2. Lower stocking rates.
3. Lower feeding rates.
4. Flushing ponds with fresh water.

STUDENT ACTIVITIES

STUDENT WORKSHEET #1 — Stocking Fish

For additional activities, teachers may refer to the "Suggested Teaching Activities and Procedures" section in the Instructor's Guide.

452

STUDENT WORKSHEET #1

Stocking Fish

Genus and Species Name ______________________________

Common Name ______________________________

Preferred Water Temperature ______________________________

Suggested Stocking Rate/Acre

Fry ______________________________

Fingerling ______________________________

Adult ______________________________

Number of Fry Stocked in:

20 gallon aquarium = ______________________________

6 foot diameter tank x 4 foot high = ______________________________

$^1/_3$ acre pond = ______________________________

483

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Feeding Fish

RELATED PROBLEM AREAS:

1. Classifying Fish
2. Managing Fish
3. Managing Hunting and Fishing Clubs
4. Managing Game Preserves
5. Identifying Basic Principles of Animal Science (Central Core Cluster)
6. Meeting the Environmental Requirements of Animals (Agricultural Business and Management Cluster)

PREREQUISITE PROBLEM AREA(S):

1. Stocking Fish
2. Meeting Nutritional Needs of Animals (Agricultural Business and Management Cluster)

LEVEL: Preparatory

OCCUPATIONAL TASKS ADDRESSED:

Agricultural Business and Management Cluster

Duty A: Formulating Livestock Feeding Programs

1. Assess livestock needs, such as growing and fattening, nursing, production, or special nutritional needs
2. Identify feed formula for livestock needs
3. Mix feed additives and medications
4. Record daily feed consumption

Agricultural Resources Cluster

Duty A: Managing the Recreational Facility

1. Requisition materials, supplies, and services
2. Follow work schedule

Duty B: Applying Laws, Regulations, and Policies

1. Interpret stream, lake, pond, and groundwater laws

Duty D: Managing Facility Flora and Fauna

1. Identify plant communities and dominant species within a selected area
2. Apply pesticides
3. Identify wildlife species within a selected area

Duty E: Perform General Office Work

1. File materials, such as receipts, letters, documents, specifications, and orders

Duty F: Using Tools, Materials, and Equipment

1. Perform preventative maintenance on equipment

Duty G: Assembling, Servicing, and Maintaining Equipment and Facilities

1. Follow a facility and grounds maintenance schedule
2. Report facility and grounds maintenance needs
3. Make electrical repairs
4. Troubleshoot equipment failure

Duty H: Applying Safety Practices

1. Store flammable and other hazardous materials safely
2. Monitor equipment for safe operation

STATE GOALS FOR LEARNING

In planning the instruction for this problem area, teachers can promote the development of several student learning objectives which are related to the State Goals for Learning in Biological and Physical Sciences and Social Sciences. These objectives are listed on the Learning Assessment Plan forms included on the following page(s). Those learning objectives marked with an asterisk (*) are taken from the sample lists provided by the Illinois State Board of Education.

Illinois Agricultural Core Curriculum
Agricultural Education 124 Mumford Hall 1301 W. Gregory Drive University of Illinois Urbana, IL 61801

Director: Dale A. Law, Ed.D.
Principal Investigator: Jerry D. Pepple, Ed.D
Research Assistant: Robert E. Petrea

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

Submission Date ____________
☐ **Original submission** ☐ **Revision** Page ____ of ____

I. LEARNING AREA *(check one)*

☐ Language Arts
☐ Mathematics
☒ Sciences
☐ Fine Arts
☐ Social Sciences
☐ Physical Development/Health

(Affix label or complete district information.)

COUNTY ☐☐☐	DISTRICT ☐☐☐☐	ESC ☐☐

District Name

City

Contact Person: ____________
Title: ____________
Phone: (   )

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will have a working knowledge of the concepts and basic vocabulary of biological, physical, and environmental sciences and their application to life and work in contemporary technological society.

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Recognize that one population of organisms can affect another.					
*2. Recognize that the populations of plants and animals change as the environment changes.					
*3. Understand that communities are affected by limiting factors.					
4. Define terms integral to feeding fish.					
5. Summarize the relationship between length of digestive system and feeding habit.					
6. Describe cultural practices and methods to meet the nutritional requirements of various aquaculture species.					

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LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

Submission Date ____________
☐ **Original submission** ☐ **Revision** Page ____ of ____

I. LEARNING AREA *(check one)*
☐ Language Arts ☐ Fine Arts
☐ Mathematics ☐ Social Sciences
☒ Sciences ☐ Physical Development/Health

(Affix label or complete district information.)
COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐
District Name
City

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will have a working knowledge of the social and environmental implications and limitations of technological development.

Contact Person: ____________
Title: ____________
Phone: (   )

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Identify materials that are replacing natural resources.					
2. Identify and describe the various mechanisms available for feeding fish.					
3. Describe cultural practices and methods to meet the nutritional requirements of various aquaculture species.					
488					489

ISBE 41-78 (1/88)

Illinois Agricultural Core Curriculum Rev.

Feeding Fish

Agricultural Resources
Fish and Wildlife Management

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Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

Submission Date ____________
☐ Original submission ☐ Revision
Page ____ of ____

(Affix label or complete district information.)

COUNTY	DISTRICT	ESC

District Name
City

Contact Person: ____________
Title: ____________
Phone: (   )

I. LEARNING AREA *(check one)*

☐ Language Arts
☐ Mathematics
☐ Sciences
☐ Fine Arts
☒ Social Sciences
☐ Physical Development/Health

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will be able to apply skills and knowledge gained in the social sciences to decision making in life situations.

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Understand the knowledge and skills required for success in selected fields of work.					
*2. Recognize that competence in a field of work entails the development of a wide range of skills.					
3. Identify and describe the various mechanisms available for feeding fish.					
4. Explain the relationship between environmental conditions and feeding rates.					
5. Describe cultural practices and methods to meet the nutritional requirements of various aquaculture species.					

Feeding Fish

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Feeding Fish

STUDENT LEARNING OBJECTIVES

Upon completion of their study of this problem area, students will be able to:

1. Define terms integral to feeding fish.
2. Identify and describe the various mechanisms available for feeding fish.
3. Differentiate between natural and manufactured foodstuffs.
4. Summarize the relationship between length of digestive system and feeding habit.
5. Describe the feeding habits of various aquaculture species.
6. Describe cultural practices and methods to meet the nutritional requirements of various aquaculture species.
7. Explain the relationship between environmental conditions and feeding rates.

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Feeding Fish

PROBLEMS AND QUESTIONS FOR STUDY

1. How is feeding fish similar to feeding other animals?
2. How is feeding fish different from feeding other animals?
3. What are natural foodstuffs?
4. How can one increase the amount of natural foodstuffs?
5. What are the different types of manufactured feed?
6. What are the mechanisms available for feeding fish?
7. What are the advantages of the various mechanisms? Disadvantages?
8. How can one decide which of the mechanisms to use?
9. Which feeding habit requires the longest digestive system?
10. Which feeding habit requires the shortest digestive system?
11. What are the main parts of the fish digestive system?
12. What foodstuffs do the various aquaculture species normally eat?
13. What manufactured feeds do the various aquaculture species consume?
14. What are the nutrient requirements of the various species?
15. What factors affect the feeding activity of fish?
16. What factors affect the rate at which fish should be fed?
17. How can one determine if one's fish are being fed enough?
18. How can one determine if one's fish are being fed too much?

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Feeding Fish

SUGGESTED TEACHING ACTIVITIES AND PROCEDURES

1. Use personnel from local feed companies, local aquaculture producers, the Illinois Department of Agriculture Fisheries Division, the Fisheries Research Laboratory at SIU, members of the Illinois Aquaculture Industries Association, and the Cooperative Extension Service as resources for specific additional information.

2. Obtain copies of the feed analysis of suggested feeds for specific species from various feed companies. Have students use Student Worksheet #1 as a guide in comparing the feeds content and suggested feeding rates.

3. Use the problem area, *Meeting the Nutritional Needs of Animals,* as a review of the roles played by the specific categories of nutrients in production animals.

4. Use Information Sheet #1 for concerns and information specific to providing nutrition to fish.

5. Use Information Sheet #2 for a listing of natural foods eaten by the shown species. Also included is information on aspects of pond preparation and maintenance for enterprises where natural food is to be provided in an extensive fish-raising operation.

6. Use Information Sheet #3 for methods and practices concerning the amounts and timing of feeding.

7. Use the Transparency Master Discussion Guide for background information specific to the transparencies.

8. Invite a representative from a feed company that produces fish feeds to address the class on research and manufacturing aspects of feed production.

9. Conduct a field trip to a producer of an aquacultural species. Information Sheet #3 in the problem area, *Stocking Fish,* can be used as a reference for possible field trip sites. Questions of concern should include:

   a. Feed source — Commercial, farm made
   b. Feed type — Sinking, floating, pelleted, meal, etc.
   c. Feed method — Hand, timer, demand, blower
   d. Calculation method for requirements — Weighing, measuring, charts
   e. Ration differences — Age, species, reproduction
   f. Common problems encountered — Water quality, non-acceptance of new rations, etc.

10. Use this problem area in conjunction with the problem areas *Stocking Fish* and *Managing Fish.* The content has been broken down for ease of delivery but all three must be viewed in the context of a whole and actions in one will affect the other two.

11. Consider setting up a classroom aquarium or, if room is available, a small water reuse system (see problem area *Stocking Fish* for a source). Practical experience in comparing feed choices can be made available. Also the systems used to perform the functions necessary in determining feed amounts can be made. Fish can be weighed. The amount of feed consumed in a set time can be measured. Growth records can be kept. Conversion rates can be figured from the amount of feed used and the amount of weight gained.

12. By using two aquarium tanks, comparisons can be made by stocking the same species in both tanks and feeding different feeds or different amounts of the same feeds. Different species can be kept in both tanks and growth rates can be compared. Water quality can be adjusted (temperature, etc.) and comparisons made of the effect on growth rates of the same species of fish. Many other opportunities for experiments are available.

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Feeding Fish

SUGGESTED TEACHING ACTIVITIES AND PROCEDURES (con't.)

13. Obtain copies of *Specialty Animal Production Curriculum Guide for Vocational Agriclture/ Agribusiness* (Bulletin #1806) for information on raising crawfish, bees, worms, crickets, and bobwhite quail for use as possible classroom activities.

14. Refer to the problem area, *Stocking Fish*, for a listing of contact persons, agencies and additional resources available that provide information relative to aquaculture.

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Feeding Fish

REFERENCES

*1. *Third Report to the Fish Farmers.* (1984). Dupree, H.K., Humer, J.V., ed. U.S. Fish and Wildlife Service, Fish Farming Experimental Station, P.O. Box 869, Highway 130E, Stuttgart, AR 72160.

*2. *Fish Farming Techniques.* (1987). Belusz, Larry. Instructional Materials Laboratory, #10 Industrial Education Building, 6th and Stewart Rd., Columbia, MO 65211. (314) 882-2883.

*3. *The Aquaculture Industry in Illinois.* (1989). Waite, S.W., Waite, J.L. 1906 Hemlock Dr., Champaign, IL 61821. (217) 351-4108.

4. *Fish Hatchery Management.* (1982). Piper, R.G., McElwain, I.B., Orme, L.E., McCraren, J.P., Fowler, L.G., Leonard, J.R. U.S. Department of the Interior, Fish and Wildlife Service, Washington, DC.

5. *Fish Farming Handbook.* (1980). Brown, E.E., Gratzek, J.B. AVI Publishing Co., Inc., Division of Van Nostrand Reinhold, 115 Fifth Avenue, New York, NY 10003-1004. (212) 254-3232.

6. *Introduction to Fish Physiology.* (1982). Smith, L.S. T.F.H. Publications, Inc., 211 W. Sylvania Ave., P.O. Box 427, Neptune, NJ 07753.

7. *Water Re-Use Systems.* Rosati, Ronald. Department of Agriculture, Illinois State University. (Presented at the 1990 Illinois Aquaculture Industry Association Convention, January 9, 1990, Decatur, IL.)

8. *Raising Catfish in Floating Cages* (#Y928) Bassett, B., Dillard, J. Missouri Cooperative Extension Service, 210 Whitten, Columbia, MO 65211. (314) 882-3226.

9. *Specialty Animal Production Curriculum Guide for Vocational Agriculture/Agribusiness* Bulletin #1806. Department of Education, Office of Vocational Education, Box 94064, Baton Rouge, LA 70804-9064.

*indicates highly recommended reference

INSTRUCTOR'S NOTES AND REFERENCES

486

INSTRUCTIONAL RESOURCES

These resources are intended for use by teachers in planning and teaching the materials for this problem area and may be adapted to fit the teaching method(s) used.

INFORMATION SHEET #1 — Fish Nutrition

INFORMATION SHEET #2 — Fish and Their Natural Foods

INFORMATION SHEET #3 — How Much to Feed and When

TRANSPARENCY MASTER #1 — Fish Digestive System (with discussion guide)

TRANSPARENCY MASTER #2 — Commercial Diets for Fish (with discussion guide)

TRANSPARENCY MASTER #3 — Compositions of Various Species Diets — I (with discussion guide)

TRANSPARENCY MASTER #4 — Compositions of Various Species Diets — II (with discussion guide)

TRANSPARENCY MASTER #5 — Level of Protein Requirements (with discussion guide)

TRANSPARENCY MASTER #6 — Feeding Schedule (with discussion guide)

TRANSPARENCY MASTER #7 — Feed Particle Size (with discussion guide)

TRANSPARENCY MASTER #8 — Types of Feeding Mechanisms (with discussion guide)

INFORMATION SHEET #1

Fish Nutrition

Fish, like all animals, need nutrients to provide the ability to perform the physiological functions of growth, reproduction, etc. Fish are also similar to land animals in that to be raised efficiently in restricted areas detailed knowledge of the nutritional requirements under various conditions must be known. Therein lies one of the differences between fish and terrestrial animals. While many of the quantitative requirements for various nutrients for several species of fish have been determined, there is much that remains to be discovered. This need for further study also applies to our understanding of the variations required in dealing with the added stresses of intensive cultures such as water reuse systems.

Fish require the nutrients of protein, energy, vitamins, and minerals. These nutrients play basically the same roles in fish as they play in other production species. Some nutrient considerations are given in the following list:

Proteins

1. The objective of fish production is to produce fish of at least 50 percent flesh on a dry weight basis.
2. Fish require a higher protein content in their food than land animals, but the requirement varies with age and physiological function.
3. Fish require the same ten essential amino acids as other production animals.
4. Weight gain in fish is linearly related to the protein content of their food between 20 and 40 percent protein. As protein content approaches 50 percent, growth and weight gain no longer increase linearly.
5. Excess protein is easily converted to energy use; thus overfeeding is expensive.
6. The quality of protein fed (providing all amino acids) is the most important factor in optimal utilization of all proteins.
7. Animal proteins are generally higher quality than plant proteins.
8. Fish cannot utilize non-protein nitrogen.

Energy

1. Fish need less energy in feeds because:
    a. Fish do not maintain a constant body temperature.
    b. Fish require little energy to excrete nitrogen by-products.
    c. Fish need less energy to maintain body position in the water than warm-blooded animals.
2. Fish process starch less efficiently than land animals.
3. Warm water fish process starch better than cool water fish.
4. Fish cease eating when their metabolic energy requirement is satisfied. Thus a diet with too much energy in relation to protein percentage can prevent adequate protein intake for optimal growth.
5. Carbohydrates are not a major source of energy for fish.
6. Carbohydrates do not supply any essential nutrients that can't be supplied by other nutrients.
7. Carbohydrates serve as precursors for non-essential amino acids needed for growth.
8. Lipids are the primary source of energy in fish. Proper balance with protein will prevent:
    a. Use of expensive protein for energy (too little).
    b. Fatty deposits (especially in salmonids) that reduce dressing percent (too much).

Vitamins

1. Moderate stocking rates usually do not cause vitamin shortages because natural foodstuffs supply sufficient quantities.
2. Total vitamin amounts increase as fish grow.
3. Food intake decreases as a percent of body weight as fish increase in size, so fortification of feeds with vitamins is necessary for older fish.
4. It is assumed that all vitamins are required by all species, though recommended amounts for different species vary.

5. Relatively moderate cost makes common the practice of supplementing vitamin requirements for a particular species.

6. Nutritional diseases such as "broken back" in channel catfish are linked to a deficient vitamin.

Minerals

1. Fish probably require the same minerals as land animals.

2. Minerals are used for nutritional and osmotic balance (between body fluids and external water) purposes.

3. Calcium requirements are normally supplied by absorption of calcium from the water as it passes across the gills.

4. Phosphorus and sulfur must be supplied by the diet.

5. Fish feeds low in animal products may be low in trace minerals.

6. Deficiencies of minerals cause reductions in growth rates.

Factors Affecting Nutritional Requirements

1. Water temperature

   a. Water temperature is probably the single most important external factor affecting fish growth. (See Transparency Master #5.)
   b. Caloric needs rise as water temperature rises (to upper limits) resulting in adjustments in feeding rates.
   c. Failure to adjust rates or caloric content will result in feed wastage (too much) or less than optimal growth (too little).
   d. Standard temperatures have been set at 50°F salmon, 59°F trout, and 85°F for channel catfish for 100 percent metabolic rate.

2. Age

   a. Growth rates decrease as fish become older.
   b. Fish never stop growing.

3. Physiological changes

   a. Fish have higher metabolic rates during spawning.
   b. Growth rates are retarded or weight loss occurs during sexual maturity.
   c. Resting fish (as during winter) have lower metabolic rates.
   d. Fish stressed by underfeeding have lower metabolic rates than actively feeding fish.

4. Water

   a. Seventy-five percent of weight gain during growth is water.
   b. Water always diffuses from the weaker ionic concentration to the stronger. Thus water readily diffuses through the gills and digestive tract of freshwater fish.
   c. Water is involved as a reactant or end product in many life system reactions.
   d. See problem area *Managing Fish* for further discussions of water quality issues.

5. Oxygen

   a. Oxygen is necessary for the oxidation reactions of chemicals that produce energy.
   b. As the fish size increases, the oxygen requirements per unit of weight decreases.
   c. Increases in oxygen requirements are caused by a number of factors, including increasing density, high nutrient feeds, stress, elevated water temperature, and increased activity (handling, harvest).
   d. Additional information can be found in the problem area, *Stocking Fish*.

6. Species

   a. Warm water fish require more energy than cold water fish within the optimal energy ranges.
   b. At the same water temperature, cold water fish have a greater energy need than warm water fish.
   c. Herbivorous fish have a lower metabolic rate than carnivorous fish, which have a high percentage of protein and minerals in their diet. (More energy is required to eliminate wastes of protein utilization than from fats and carbohydrates.)

6. Body size

   a. Energy requirements are greater per unit of weight for smaller than for larger fish.

INFORMATION SHEET #2

Fish and Their Natural Foods

The following list is general in nature and provides examples of natural foods eaten by the listed species. While the majority can be described as omnivorous, it is interesting to note the differences found under that heading.

Species	Foodstuffs
Baitfish (Golden shiners, ornamentals)	Omnivorous (phytoplankton, zooplankton, benthic insects, mollusks)
Tilapia	Omnivorous (phytoplankton, zooplankton, benthic worms, insect larvae, clams, snails, detritus)
Paddlefish	Omnivorous (zooplankton, aquatic insects)
Trout, Salmon	Carnivorous (insects, fish)
Buffalo	Omnivorous (sucks up benthic insects, mollusks, detritus)
Sturgeon	Omnivorous (aquatic organisms)
Common Carp	Omnivorous zooplankton, phytoplankton, benthic materials, detritus (not piscivorous)
Bass	Piscivorous (fishes)

The natural food which a species normally consumes is of importance to the producer, because by increasing the amount of natural food present, less purchased feed will have to be used. This alternative is most important to the extensive system in which no feed or only a supplementary feed is fed. Intensive systems, because of high densities (no opportunity to increase natural foods because of consumption), cages (which do not allow movement), or water reuse systems (in which natural foods are simply not available) rely on complete feeds to provide all the specific requirements.

Within a pond system one of the important techniques to provide not only an adequate natural food source, but also to help in maintaining water quality, is pond preparation. Once the site has been selected (see problem area *Stocking Fish*) or a pond has been drained, several considerations are of benefit.

1. Complete drying of an existing pond will allow oxidation of organic materials, nitrite, and hydrogen sulfide from the previous year. The addition of agricultural lime (1,000 lbs. per acre is recommended) will benefit by killing infectious organisms, parasites, insects, and predator and competitor fish in addition to providing buffering capacity. Disking may be advisable to reduce nutrient-rich sediment that encourages undesirable production of blue-green and filamontous algae.

2. Complete drying of an existing pond will allow for levee inspection, bottom maintenance for harvesting ease, and installation or upkeep on catch basins.

3. On a new impoundment or those with relatively little organic material, a cover crop of rye around the edges can aid in preventing erosion. The crop will be cut and partially dried before filling and can be used as an organic fertilizer.

4. A preemergence herbicide may be needed to retard rooted vegetative growth until the desirable phytoplankton can be established.

5. The water source to be used for filling needs to be considered. Open sources will require some form of filter (see problem area *Stocking Fish*) for removal of debris and organisms. Well water will require screens or baffles to break the column into droplets to allow incorporation of oxygen from the atmosphere.

6. Fertilization of a pond increases the quantity and quality of food organisms for consumption by fish. The increased number of food organisms retard the growth of aquatic vegetation by causing turbidity (clouding of the water) which reduces the penetration of sunlight needed for growth.

7. Phytoplankton are the main producers of dissolved oxygen in the pond, and maintaining an acceptable level, dependent on species, is of prime importance. "Plankton blooms" are heavy densities of phytoplankton. Phytoplanktons are also a main food of zooplankton. Phytoplankton help control unwanted aquatic growth.

8. Zooplankton are a main food source for baitfishes, hobby fishes, fry of all types, and numerous fingerlings. Rotifers (microscopic animals similar to worms) and minute crustaceans (fairy shrimp, water fleas, seed shrimp, and copepods) are of prime consideration in fertilizing a pond.

9. Benthic material consists of bottom dwelling organisms such as insect larvae, true worms, clams, snails, bacteria, fungi, and other microbes. Bacteria and fungi are particularly important for their role in decomposition that makes inorganic nutrients available to plants for recycling. Problems are encountered when organic matter accumulates (from heavy feeding or lengthy periods without draining) and all the oxygen is used up in decomposition, allowing noxious compounds (NH_3, CO_2, Fe) to accumulate. At this point benthic organisms are reduced until conditions improve.

10. Fertilizers may be inorganic or organic.

    a. Inorganic fertilizers should be rich in nitrogen and phosphorus (16-20-0). Dry fertilizers may be used in platforms or floats to allow slow seepage of nutrients. Liquid fertilizers may provide quicker results and liquid may not be as likely to adhere to particles in the pond bottom prior to use by organisms.

    b. Organic fertilizers may be manure, hay, or plant by-products (oilseeds or grains). Use is more applicable to fry and small fingerlings than "grow out," because organic materials are known to encourage blue-green algae which when degraded by microbes may lead to dissolved oxygen depletion.

INFORMATION SHEET #3

How Much to Feed and When

Advice on exactly how much to feed fish is as varied as the sources used.

Rule of Thumb — Many references for warm water species advise to feed all the feed that the fish will clean up in 10 - 15 minutes. This is feed that is manufactured for the particular species (or a substitute as in feeding catfish food to tilapias).

Transparency Masters #4 and #5

The information on these transparencies indicates a certain percentage of body weight as the amount of feed to provide. The body weight of fish can be determined by weighing a number of fish (say 50) and dividing the total weight by the number of fish. This average can then be used as the weight against which the feeding rate (in percent of total fish weight) is determined. The feeding rate is found by reading across from the appropriate water temperature in the chart in Transparency Master #5. The percentage can then be taken times the number of fish to determine the total amount of feed that should be fed. For example, if we were feeding 100 fish, the average weight of which we determined to be one pound, and which were living in water at 75°F, the calculation would be as follows:

100 fish x 1 pound x 2.5% feed allowance = 2 pounds feed

This can be done at the beginning of the week to determine the amount to feed the coming week. As fish grow, an allowance for extra weight will need to be made by feeding more feed. Handling fish is very stressful on them. After several weeks an estimate can be made based on past increases to determine the feed needed. This will allow longer periods between handling.

When to Feed

Transparency Master #5 also includes a chart that shows feeding frequencies and rates dependent on water temperature. There is agreement that feeding should occur at the same time of day in the same place. It is recommended that feeding occur at midmorning to midafternoon. Midmorning allows oxygen levels to recover from the previous night. Midafternoon allows time for oxygen use by fish after feeding before oxygen levels begin to drop.

Spring — Begin feeding lightly when water temperatures reach 60°F and slowly increase to a full feeding schedule at 65°F. (For warm water species.)

Fall — Discontinue feeding when water temperatures fall below 60°F or when fish fail to eat all feed for three days in a row.

Summer — Feeding will need to be reduced or suspended briefly when temperatures reach the upper limits.

When more than one feeding per day is used, the total amount fed is divided among the feedings. Frequent feedings benefit fry and fingerlings because they will use the feed more efficiently.

Conversion Factors

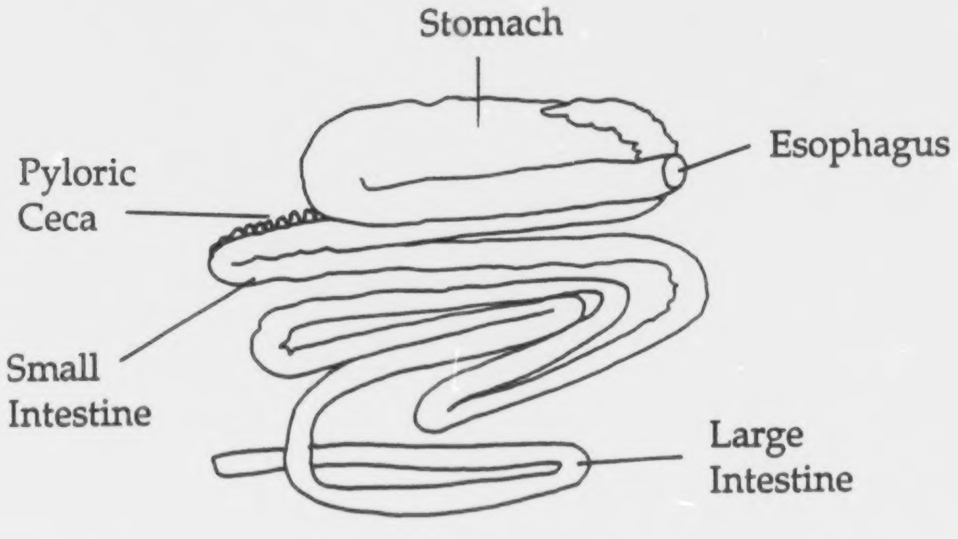
Another method of determining the amount of feed is to use feeding guides. Feeding guides incorporate a calculation that compensates for how well fish convert feed into flesh. A factor used for catfish is 1.5 to 1, which means for every 1.5 pounds of feed, one pound of flesh is produced. This rate is considerably better than most animals.

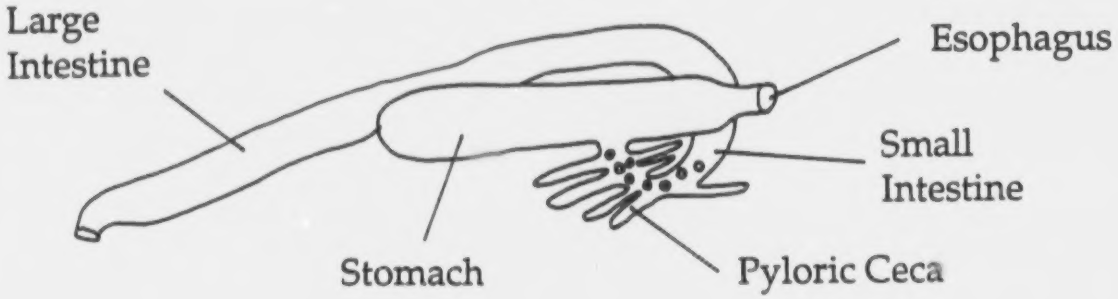
Example: Feeding Guide for 400, 6- to 8-inch catfish fed at 3 percent body weight, 6 days per week (values in pounds).

Week	Start Weight	Daily Ration	Weekly Ration	Weight Gain	End Weight
1	38.0	1.1	6.8	4.5	42.5
2	42.5	1.2	7.6	5.1	47.6
3	47.6	1.4	8.5	5.7	53.3
4	53.3	1.6	9.6	6.4	59.7
5	59.7	1.7	10.7	7.1	66.8

TRANSPARENCY MASTER #1

Fish Digestive System


Stomach
Esophagus
Pyloric Ceca
Small Intestine
Large Intestine


Large Intestine
Esophagus
Small Intestine
Stomach
Pyloric Ceca

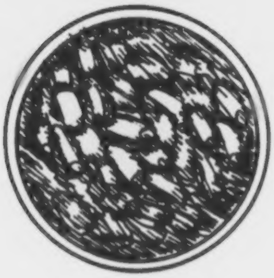
A. **Characin (Characinidae)**

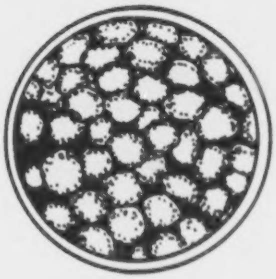
B. **Salmonid**

TRANSPARENCY MASTER #2

Commercial Diets for Fish

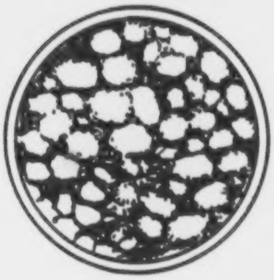
Pelleted

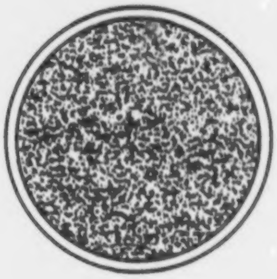




Expanded (floating)

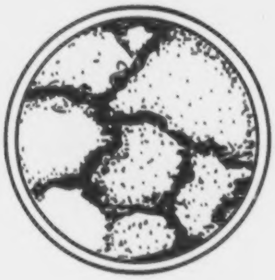
Extruded (nonfloating)

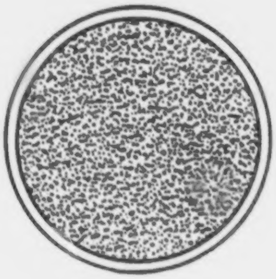




Meal

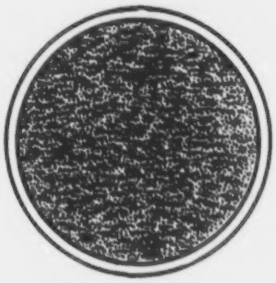
Flaked

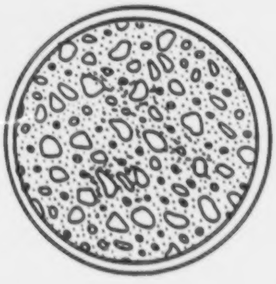




Freeze-dried reground

Crumbled pellets (larval fish)





Crumbled pellets (fingerlings)

TRANSPARENCY MASTER #3

Compositions of Various Species Diets — I

Ingredient	Channel Catfish (%)	Trout (%)
Fish meal: menhaden	10	
herring		31
Soybean meal: 44% protein	51.2	15
Yellow corn	22.7	
Distillers' dried solubles	7.5	
Wheat	5	
Wheat middlings		20
Dried whey	8	
Brewers' yeast		5
Blood flour	10	
Kelp meal	3	
Animal fat	2	
Herring oil	2	
Lignin sulfonate		2
Dicalcium phosphate	1	
Vitamin concentrate	0.5	0.5
Iodized salt	3.5	
Trace mineral mix	0.08	

U.S. Fish and Wildlife Service

TRANSPARENCY MASTER #4

Compositions of Various Species Diets — II

	Flaked Aquarium Fish (%)	Freeze-dried Larval Fish (%)
Ingredient		
fish flour (anchovy)	27	35
shrimp waste flour (with heads)	24	20
soybean flour (49% protein)	24	
rice polishings flour	10	
wheat bran flour	10.8	
fish oil	4	5
wet fish flesh		40
marigold petal flour	0.13	
vitamin mix	R	R
Nutrient		
protein	40	65
lipids	6	8.4

Ingredient	Golden Shiners (%)
Fish meal (anchovy)	10
Soybean meal (49% protein)	57
Meat and bone meal	5
Corn meal	16
Distillers' dried solubles	7.5
Corn and wheat flakes	
Animal fat	3.5
Dicalcium phosphate	0.5
Dried whey	
Vitamin mix	0.5

U.S. Fish and Wildlife Service

TRANSPARENCY MASTER #5

Level of Protein Requirements

Protein requirements (percent of total ration, by weight) for rapid growth in different kinds of fish

Species	Fry to fingerlings	Fingerlings to subadults	Adults and brood fish
Eel	50 - 60	45 - 50	
Channel catfish	35 - 40	25 - 36	28 - 32
Largemouth bass	40	40	35
Striped bass	40	36	35
Common carp	43 - 47	37 - 42	28 - 32
Trout and salmon	50	35 - 40	30 - 32

Suggested maximum feeding rates and frequencies for channel catfish

Water temperature (°F)	Feeding frequency (times per day)	Feeding rates (% of total fish weight)
> 90	1	1
80 - 86	2	3
68 - 80	1	2 ½
58 - 68	1	1 ½
50 - 58	0.5[A]	¾ - 1
< 50	0.3[B]	½ - 1

[A] Feed once on alternate days
[B] Feed once every 3 to 4 days

U.S. Fish and Wildlife Service

TRANSPARENCY MASTER #6

Feeding Schedule

Rainbow Trout

Water temperature		Fish size (cm)									
(°C)	(°F)	2 -5	5-7	7-10	10-12	12-15	15-18	18-20	20-23	23-25	25
		(% of Weight/Day)									
7	44.6	3.1	2.5	1.9	1.4	1.2	1.0	0.9	0.7	0.6	0.6
8	46.4	3.4	2.8	2.1	1.6	1.3	1.1	0.9	0.8	0.7	0.6
9	48.2	3.8	3.0	2.3	1.7	1.4	1.2	1.0	0.9	0.8	0.7
10	50.0	4.2	3.3	2.5	1.9	1.5	1.3	1.1	1.0	0.8	0.8
11	51.8	4.5	3.6	2.7	2.0	1.6	1.4	1.2	1.0	0.9	0.8
12	53.6	4.9	3.9	2.9	2.2	1.8	1.5	1.3	1.1	1.0	0.9
13	55.4	5.3	4.3	3.2	2.4	1.9	1.6	1.4	1.2	1.1	1.0
14	57.2	5.8	4.7	3.5	2.6	2.1	1.8	1.5	1.3	1.2	1.1
15	59.0	6.3	5.1	3.8	2.8	2.3	1.9	1.6	1.4	1.5	1.2
16	60.8	5.5	5.5	4.2	3.2	2.5	2.1	1.7	1.6	1.4	1.3

Source: Am. Fish. U.S. Trout News (1969)

Channel Catfish

Date	Water temperature (°F)	Fish weight (pounds)	Feed allowance per day (% of fish weight)
Apr 15	68	0.04	2.0
Apr 30	72	0.06	2.5
May 15	78	0.11	2.8
May 30	80	0.16	3.0
Jun 15	83	0.21	3.0
Jun 30	84	0.28	3.0
Jul 15	85	0.35	2.8
Jul 30	85	0.42	2.5
Aug 15	86	0.60	2.2
Aug 30	86	0.75	1.8
Sep 15	83	0.89	1.6
Sep 30	79	1.01	1.4
Oct 15	73	1.10	1.1

Feed allowances are based on data obtained with rations containing 36 percent protein and about 2.88 kcal of digestible energy per gram of protein. If feeds of lower protein and energy concentrations are used, daily allowances should be increased proportionally. Data adapted from R. T. Lovell. 1977. Feeding practices. Pages 50 - 55 in Nutrition and feeding of channel catfish. Southern Cooperative Series Bulletin 218. Alabama Agricultural Experiment Station, Auburn University, Alabama.

TRANSPARENCY MASTER #7

Feed Particle Size

Optimum feed particle size, and screen number that separates that size, for channel catfish and other commonly produced warm water fishes.[a,b]

Length of fish (inches)	Designated particle size (No.)	U.S. screen No.	Range in diameter of particles (mm)
Fry (< 0.5)	0	40	0.420 - 0.595
0.5 - 1.0	1	30	0.595 - 0.841
1.0 - 1.5	2	20	0.841 - 1.19
1.5 - 2.5	3	16	1.19 - 1.68
2.5 - 4.0	4	12	1.68 - 2.38
4.0 - 6.0	5	8	2.38 - 3.36
> 6.0	$^3/_{16}$- inch pellet		

[a] A system of screens is used to separate feed particles into designated particle sizes. For example, screen No. 20 retains all particles larger than 0.841 mm and passes through all particles smaller than 0.841 mm onto screen No. 30, and screen No. 30 retains particles larger than 0.595 mm, and passes through particles smaller than 0.595 mm. Thus only particles of screen No. 1 (0.595 - 0.841 mm in diameter) then remain on screen No. 30.

[b] Adapted from National Research Council, 1981. Nutrient requirements of cold water fishes. No. 16 in Nutrient requirements of domestic animals. National Academy of Sciences, Washington, D.C.

Feeding of Golden Shiners

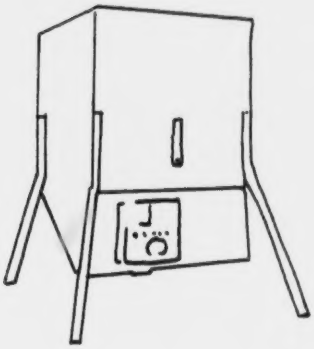
Treatment	Yield lb/acre	kg/ha
Fertilization only	410	460
Fertilization, high fish meal diet	656	736
Fertilization, low fish meal diet	629	706
Fertilization, all plant diet	605	679

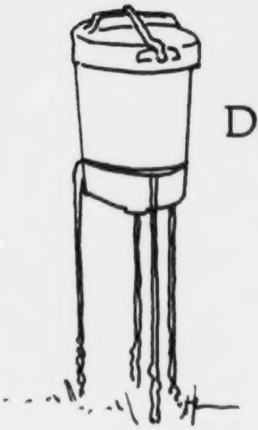
U.S. Fish and Wildlife Service

TRANSPARENCY MASTER #8

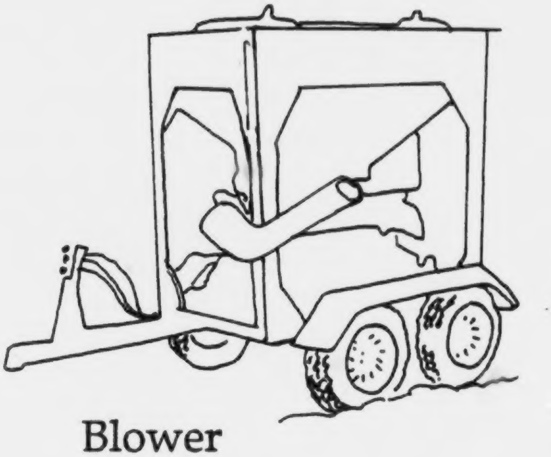
Types of Feeding Mechanisms

Timer



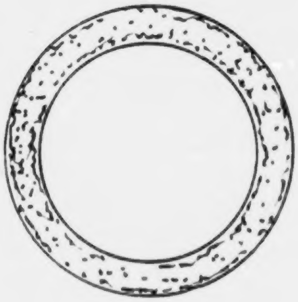


Demand



Blower

Feeding Ring



TRANSPARENCY MASTER DISCUSSION GUIDE

Transparency Master #1

This transparency illustrates variations of digestive tracts found in fish. A general statement of the main components and their function is as follows:

1. The *mouth* is used to capture and take in feeds. Most fish do not chew their food, but gulp it down intact. Pharyngeal teeth are used by some species to grind feed.
2. The *gizzard* serves as a grinding mechanism in some species of fish.
3. The *stomach* is for feed storage and preliminary digestion of protein. Very little absorption occurs in the stomach.
4. The finger-like *pyloria ceca* at the junction of the stomach and small intestines are a primary source of digestive juices.
5. The *small intestine* is the major site of digestion and receives the digestive juices secreted by the liver, pancreas, pyloric ceca, and intestinal walls. The absorption of the nutrients occurs in this area.
6. Some water absorption occurs in the *large intestine*, but its primary function is to serve as a reservoir of undigested materials before expulsion as feces.

While the general processes of fish digestion have not been thoroughly studied, the following seem apparent:

1. Fish digestion processes are similar to those of other vertebrates.
2. Even though a species may have a particular preference for certain items, most fish can switch to something quite different when the preferred food becomes unavailable.

Generalizations

1. Most herbivores have specialized chewing structures to utilize plant material.
2. Omnivores have minimally specialized structures.
3. Carnivores may specialize in a particular type of prey.
4. Digestive tract length correlates with diet.
   a. Herbivores have longer tracts than carnivores.
   b. Tract length seems related more to the amount of indigestible material than whether the origin is plant or animal.
5. Intestines with folds are shorter than simple tubular arrangements.
6. Tract length may change with age due to a change in diet.
7. Tract length may change due to sparseness (longer) or ampleness (shorter) of diet.
8. Tract length may change seasonally with changes in food kind.

Transparency Master #2

This transparency illustrates the various types of feeds available, including (a) pelleted, for catfish and trout, (b) expanded (floating), for catfish and trout, (c) extruded (nonfloating), for prawns and shrimps, (d) meal, for bait fish and ornamental fish in ponds, (e) flaked, for aquarium fish, (f) flaked or freeze-dried and reground, for larval fish in rearing tanks, (g) crumbled pellets, for larval fish, and (h) crumbled pellets, for catfish and trout fingerlings.

In each of the types one can obtain either complete or supplemental feed.

1. Complete Feed — One that provides all the protein, lipids, energy, vitamins, and minerals that are required. Complete feeds are more expensive because they contain all the nutrients required. Another reason for the higher price is that of the 30-50 percent crude protein provided, 10-25 percent of that protein comes from fish meal. Studies have shown a significant increase in weight gain by using animal protein as opposed to plant protein.
2. Supplemental feed — One that supplies additional protein and energy. The natural foodstuffs consumed are expected to provide all additional growth elements absent from the feed.

Another question for consideration is the form in which feed is fed. The main categories are sinking and floating.

1. Sinking feeds have an advantage of being cheaper. However, more management is required because pellets that fall to the bottom are usually not found by the fish. Sinking feeds may also retain more of the vitamins present, as the processing temperatures are not as high.

2. Floating feeds are higher in cost, but make up a majority of the feed purchased. The advantages of floating feed are greater water stability, visibility of unconsumed feed, and greater ability to observe signs of stress and disease in the fish. In addition, some culturing practices such as cages or tanks require the use of floating feeds for water quality and consumption reasons. Studies have shown 75 percent sinking and 25 percent floating can achieve gains similar to all floating feed under proper management.

Additional information on some of the feeds illustrated in the transparency:

1. Meal-type feeds have been used in ponds for tilapia also. Tilapia are continuous feeders and efficiently use natural organisms. Most wasted feed will supplement bacteria, phytoplankton, and zooplankton which will then be used by tilapia.

2. The different sizes of crumbled pellets represent the matching of the diet to the physiological requirement of size (age) of the fish. The smaller size is needed by the smaller fish which can not consume the larger pellets. Fingerlings are larger and can use a larger crumble, while still consuming a majority of the feed.

Types of feed not shown in the transparency include:

1. Brine shrimp — Frozen or freeze-dried for larval fish.

2. Dough type — Made like bread dough for eel production.

Transparency Masters #3 and #4

These transparency masters illustrate samples of feed compositions for the listed species. One notices the differences in protein source used for the warm water and cold water species, and also the differences in the larval fish constituents and those used in the channel catfish and trout diets.

Transparency Master #5

This transparency illustrates recommendations of protein levels for the listed species at the listed ages. Fry require the highest levels for growth and, like land animals, requirements decrease with size.

Also represented is a suggestion on the frequency of feeding channel catfish. The frequency is related to the water temperature and its effect on feeding activity.

Transparency Master #6

This transparency illustrates the effect of water temperature on feeding rate. Cool water species will gain at temperatures of 9°-21°C (48-70°F) with an optimum temperature of 15°C (16°F). Warm water species will gain in a range of 21°-31°C (70-88°F) with an optimum temperature of 30°C (86°F). The amount of feed required is dependent on many factors besides water temperature, species, and age. These include sex, reproductive state, water chemistry, water oxygen content, time of day, density level, disease, and culturing practice.

Transparency Master #7

This transparency illustrates suggested particle sizes for the size of fish listed. Particle size needs to be related to the physical size of the fish so that the size is neither so large that it is not useable by the fish nor so small that feed is wasted because the fish is not able to consume it before it breaks apart and/or falls to the bottom.

Also listed is a comparison of the increase of production to supplemental feeding of golden shiners. As can be seen, a considerable increase (approximately 50 percent) was found by feeding over simply fertilizing the pond. When comparing the protein sources within the feeds, the increase in production by using the more expensive source (fish meal) was not justified. This can partly be explained by the fact that golden shiners make good use of plant protein, either as feed itself or as a result of feeding on plankton which have utilized the protein.

Transparency Master #8

This transparency illustrates five types of feeding mechanisms used in aquaculture.

1. Hand feeding is useful in small enterprises and in extensive situations, such as with fry or small fingerlings, when feed is spread along the shoreline.

2. Feeding rings are used in larger ponds to facilitate keeping the feed from being dispersed by wind and wave action. A ring can be made from black rolled plastic with a water-tight connection to hold the

ends together. The size used may be dependent on fish size, but 30 feet is a good size. The ring should be anchored in three feet of water.

3. Timer feeders offer convenience by feeding automatically at the same time or times each day. Accurate settings are required to ensure neither too much nor too little feed. Fish travel only short distances to feed and several feeders may be required in large areas. Also, dominant fish may have an advantage leading to unequal growth.

4. Demand feeders are activated by fish pushing on a rod. Demand feeders can offer a continuous supply of feed when the fish want it. Demand feeders can be used in extensive culture when densities make efficient consumption of offered feed difficult. Use of demand feeders in raceways is possible and water quality problems may occur in ponds.

5. Blower feeders can be movable (as shown), vehicle-mounted, or stationary. These feeders provide ease of delivery for large quantities.

STUDENT ACTIVITIES

STUDENT WORKSHEET #1 — Fish Feed Comparison

For additional activities, teachers may refer to the "Suggested Teaching Activities and Procedures" section in the Instructor's Guide.

STUDENT WORKSHEET #1

Fish Feed Comparison

Using the content analysis card of two different feeds for a specific species, compare the ingredients and feeding recommendations.

Feed #1

Fish Species ________ Feed type (circle) Complete or Supplemental

Age

Feed form (circle) Pelleted Crumbled Meal Flaked Expanded Extruded Other ________

(circle) Floating Sinking

Protein: Major source (circle) Plant Animal
Total ________ % Ingredients ________ ________ ________ %

Energy: Major source
Total ________ % Ingredients ________ ________ ________ %

Vitamin: Major source
Total ________ % Ingredients ________ ________ ________ %

Minerals: Major source
Total ________ % Ingredients ________ ________ ________ %

Recommended feeding rate:

Other ingredients:

Does this feed meet the recommendations for this species and age?

If no, list lacking requirements.

How can these requirements be met?

Feed #2

Fish Species ______________ Feed type (circle) Complete or Supplemental

Age

Feed form (circle) Pelleted Crumbled Meal Flaked Expanded Extruded Other ______________

(circle) Floating Sinking

Protein: Major source (circle) Plant Animal
Total ________ % Ingredients ________ %
____
____

Energy: Major source
Total ________ % Ingredients ________ %
____
____

Vitamin: Major source
Total ________ % Ingredients ________ %
____
____

Minerals: Major source
Total ________ % Ingredients ________ %
____
____

Recommended feeding rate:

Other ingredients:

Does this feed meet the recommendations for this species and age?

If no, list lacking requirements.

How can these requirements be met?

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Managing Fish

RELATED PROBLEM AREAS:

1. Classifying Fish
2. Managing Hunting and Fishing Clubs
3. Managing Game Preserves
4. Managing Entrepreneurship Opportunities in Agriculture (Agricultural Business and Management Cluster)
5. Maintaining Animal Health (Agricultural Business and Management Cluster)
6. Agribusiness Operation and Management Unit (Agricultural Business and Management Cluster)

PREREQUISITE PROBLEM AREA(S):

1. Stocking Fish
2. Feeding Fish

LEVEL: Preparatory

OCCUPATIONAL TASKS ADDRESSED:

Agricultural Resources Cluster

Duty A: Managing the Recreational Facility

1. Complete invoices
2. Requisition materials, supplies, and services
3. Maintain inventory records
4. Maintain equipment maintenance records
5. Follow work schedule
6. Contribute to annual park management update
7. Complete business forms
8. Communicate orally with visitors
9. Assist in assessing and collecting fees and charges

Duty B: Applying Laws, Regulations, and Policies

1. Maintain permits, certificates, and licenses
2. Prepare service work order
3. Post facility directions and warnings
4. Post facility rules and regulations
5. Maintain facility sanitation

Duty C: Performing Promotional Activities

1. Give information and directions in a variety of formal and informal settings

Duty E: Performing General Office Work

1. File materials, such as receipts, letters, documents, specifications, and orders
2. Process incoming telephone calls
3. Process outgoing telephone calls

Duty H: Applying Safety Practices

1. Monitor equipment for safe operation
2. Maintain shields, guards, and other safety devices on tools and equipment

STATE GOALS FOR LEARNING

In planning the instruction for this problem area, teachers can promote the development of several student learning objectives which are related to the State Goals for Learning in Biological and Physical Sciences and Social Sciences. These objectives are listed on the Learning Assessment Plan forms included on the following page(s). Those learning objectives marked with an asterisk (*) are taken from the sample lists provided by the Illinois State Board of Education.

Illinois Agricultural Core Curriculum
Agricultural Education 124 Mumford Hall 1301 W. Gregory Drive University of Illinois Urbana, IL 61801

Director: Dale A. Law, Ed.D.
Principal Investigator: Jerry D. Pepple, Ed.D.
Research Assistant: Robert E. Petrea

Illinois Agricultural Core Curriculum Rev.

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

Submission Date ____________
☐ Original submission ☐ Revision
Page ____ of ____

I. LEARNING AREA *(check one)*
☐ Language Arts ☐ Fine Arts
☐ Mathematics ☒ Social Sciences
☐ Sciences ☐ Physical Development/Health

(Affix label or complete district information.)
COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐
District Name
City

Contact Person: ____________
Title: ____________
Phone: (   )

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will be able to apply the skills and knowledge gained in the social sciences to decision making in life situations.

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Evaluate the costs and benefits of a particular course of action.					
*2. Understand the knowledge and skills required for success in selected fields of work.					
*3. Recognize that competence in a field of work entails the development of a wide range of skills.					
4. Summarize factors involved in marketing aquaculture species.					
5. Describe concerns related to and techniques of harvesting, holding, and transporting fish.					
6. Explain the role of stress in the management of fish and its relation to water quality, stocking, feeding, and harvesting fish.					
					520
519					

ISBE 41-78 (1/88)

Agricultural Resources
Fish and Wildlife Management

Managing Fish

Submission Date ______________
☐ Original submission ☐ Revision
Page ____ of ____

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

(Affix label or complete district information.)

COUNTY	DISTRICT	ESC

District Name
City

I. LEARNING AREA *(check one)*

☐ Language Arts
☐ Mathematics
☒ Sciences
☐ Fine Arts
☐ Social Sciences
☐ Physical Development/Health

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will have a working knowledge of the principles of scientific research and their application in simple research projects.

Contact Person: ______________
Title: ______________
Phone: (   )

III. LEARNING OBJECTIVES

By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:

III. LEARNING OBJECTIVES	IV. ASSESSMENT A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	V. EXPECTATIONS Percent of Students Expected to Achieve Objective
*1. Demonstrate the ability to draw conclusions from collected data.					
2. Describe the symptoms, prevention methods, and control techniques associated with fish diseases.					

Illinois Agricultural Core Curriculum Rev.

Managing Fish

Agricultural Resources
Fish and Wildlife Management

4

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

Submission Date ____________

☐ Original submission ☐ Revision

Page ____ of ____

I. LEARNING AREA *(check one)*

☐ Language Arts
☐ Mathematics
☒ Sciences
☐ Fine Arts
☐ Social Sciences
☐ Physical Development/Health

(Affix label or complete district information.)

COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐

District Name

City

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will have a working knowledge of the social and environmental implications and limitations of technological development.

Contact Person: ____________
Title: ____________
Phone: (   )

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Analyze the properties of water that cause it to be vital to an ecosystem.					
*2. Identify materials now in use that are replacing natural resources.					
3. Outline the various components of water quality.					
4. Explain the role of stress in the management of fish and its relation to water quality, stocking, feeding, and harvesting fish.					
523					524

ISBE 41-78 (1/88)

Submission Date ____________

☐ Original submission ☐ Revision

Page ____ of ____

I. LEARNING AREA *(check one)*

☐ Language Arts ☐ Fine Arts

☐ Mathematics ☐ Social Sciences

☒ Sciences ☐ Physical Development/Health

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

(Affix label or complete district information.)

COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐

District Name

City

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will have a working knowledge of the concepts and basic vocabulary of biological, physical and environmental sciences and their application to life and work in contemporary technological society.

Contact Person: ____________

Title: ____________

Phone: (   )

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Recognize that one population of organisms can affect another.					
*2. Understand the principle of cause and effect as it applies to disease.					
*3. Understand how a micro-organism moves, excretes waste, obtains food, responds to stimuli, and reproduces within its environment.					
4. Define terms integral to managing fish.					
5. Predict the results of undesirable levels of the various components of water quality.					
6. Describe the symptoms, prevention methods, and control techniques associated with fish diseases.					
7. Explain the rule of stress in the management of fish and its relation to water quality, stocking, feeding, and harvesting fish.					

ISBE 41-78 (1/88)

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Managing Fish

STUDENT LEARNING OBJECTIVES

Upon completion of their study of this problem area, students will be able to:

1. Define terms integral to managing fish.
2. Outline the various components of water quality.
3. Predict the results of undesirable levels of the various components of water quality.
4. Describe the symptoms, prevention methods, and control techniques associated with fish diseases.
5. Summarize factors involved in marketing aquaculture species.
6. Describe concerns related to and techniques of harvesting, holding, and transporting fish.
7. Explain the role of stress in the management of fish and its relation to water quality, stocking, feeding, and harvesting fish.

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Managing Fish

PROBLEMS AND QUESTIONS FOR STUDY

1. What is water quality?
2. What are the components of water quality?
3. What are the desirable levels of the various water quality components?
4. How does one manage the water quality components?
5. What are the results of undesirable levels of the various water quality components?
6. What are the symptoms of fish disease?
7. Why can't one diagnose fish diseases from what one observes?
8. Where can one get help in diagnosing fish diseases?
9. How does one prevent fish diseases?
10. What are the control measures of fish diseases?
11. What markets are available for aquaculture species?
12. What factors does one need to consider in marketing fish?
13. What are the methods of harvesting fish?
14. What are the advantages and disadvantages of the different methods of harvesting fish?
15. Why does one need to be concerned with holding fish?
16. How does one hold fish?
17. What are the main problems with holding fish?
18. What are the methods available for transporting fish?
19. What are the main concerns of transporting fish?
20. What is stress?
21. Why is stress so important?
22. What are the results of stress?
23. What factors can be monitored to lessen stress?

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Managing Fish

SUGGESTED TEACHING ACTIVITIES AND PROCEDURES

1. Use personnel from the Illinois Department of Agriculture Fisheries Division, the Fisheries Research Laboratory at SIU, members of the Illinois Aquaculture Industries Association, the Cooperative Extension Service, and local fishing clubs as resources for additional specific information.

2. Obtain copies of *Management of Small Lakes and Ponds in Illinois* for use as a student resource and reference. The booklet contains information for the general public on pond construction, pond management, fish species facts, fishing and fishing maintenance, fish diseases, and a reference list of publications and fisheries offices.

3. Obtain copies of the following pamphlets from the Department of the Interior, Fish and Wildlife Service, Fish Farming Experimental Laboratory, P.O. Box 860, Stuttgart, AR 72160. These pamphlets can be used as student references and study resources:

   Some Parasites and Diseases of Warmwater Fishes (leaflet #6), and *Treatment Tips for Fish Producers (leaflet #15) Submitting Samples for Fish Disease Diagnosis*

4. Use Chapter 3 of *The Aquaculture Industry of Illinois* as a reference for student use for information about marketing aquaculture products and producer concerns associated with the current state of the industry, future trends, market availability, etc. This chapter can be used in conjunction with Transparency Masters #6 - 9.

5. Obtain copies of *Turning Your Skills Into a Business*. This four-page pamphlet contains an outline to follow to organize a business plan and marketing strategy. This pamphlet is available from Norma A. Turok, Area Cooperative Extension Adviser, 901 W. Washington, Benton, IL 62812.

6. Obtain videotapes on aquaculture topics for classroom presentation. These videotapes cover a variety of subjects, including production, feeding, and packaging. See the reference list for a complete listing.

7. Conduct a field trip to a producer of an aquaculture species. Information Sheet #3 in the problem area *Stocking Fish*, can be used as a reference for possible field trip sites. Questions of concern should include:

   Production objective — Brood stock, fry, fingerlings, food fish.
   Stock source — Self, commercial, government.
   Feeding technique — Source, type, equipment, rate, frequency.
   Production type — Pond, tank, water reuse, combination.
   Production features — Equipment, testing, etc.
   Harvesting method — Seining, trapping, traps.
   Holding facility — Type, concerns.
   Disease control — Prevention techniques, treatment method, common problems.
   Marketing — Market area, processing, size.
   Financing — Commercial, governmental.

8. Use the problem areas in the Central Core Cluster Unit D "Basic Agribusiness Principles and Skills" for introductory material and Agricultural Business and Management Cluster Unit A, "Agribusiness Operation and Management" for advanced material in the various concerns associated with business operation and management.

9. Use this problem area in conjunction with the problem areas *Stocking Fish* and *Feeding Fish*. The content has been broken down for ease of delivery, but all three must be viewed in the context of a whole and actions in one will affect the other two.

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Managing Fish

SUGGESTED TEACHING ACTIVITIES AND PROCEDURES (con't.)

INSTRUCTOR'S NOTES AND REFERENCES

10. Consider setting up a classroom aquarium or, if room is available, a small water reuse system (see problem area *Stocking Fish* for a source). These systems will allow for practical experience in all areas of aquaculture management: species selection; species requirements; feeding rate, type and frequency; water quality maintenance and testing, etc. If a small water reuse system is used, then harvesting method, market for production, transportation, and other concerns can be incorporated.

11. Two aquarium tanks can be used to run experiments using one tank as the control and the other for the variable. Or different management variables such as stocking density, feeding rates, water quality standards, aeration, etc., can be used in each tank and the results compared and contrasted. A step further could be taken by stocking one tank with warm water fish and the other with cool water fish and management differences noted.

12. Obtain copies of the Illinois Department of Conservation Publication "Aquatic Weeds — Their Identification and Methods of Control." This booklet could be used in collecting and identifying aquatic weeds as a student activity.

13. Refer to the problem area *Stocking Fish* for a listing of contact persons, agencies, and additional resources available that provide information relative to aquaculture.

14. Obtain copies of *Specialty Animal Production Curriculum Guide for Vocational Agriculture/ Agribusiness* (Bulletin #1806) for information on raising crawfish, bees, worms, crickets, and bobwhite quail for use as possible classroom activities.

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Managing Fish

REFERENCES

*1. *Third Report to the Fish Farmers*. (1984). Dupree, H.K., Humer J.V., ed. U.S. Fish and Wildlife Service, Fish Farming Experimental Station, P.O. Box 869, Highway 130E, Stuttgart, AR 72160.

*2. *Fish Farming Techniques*. (1987). Belusz, Larry. Instructional Materials Laboratory, #10 Industrial Education Building, 6th and Stewart Rd., Columbia, MO 65211. (314) 882-2883.

*3. *The Aquaculture Industry in Illinois*. (1989). Waite, S.W., Waite, J.L. 1906 Hemlock Dr., Champaign, IL 61821. (217) 351-4108.

4. *Fish Hatchery Management*. (1982). Piper, R.G., McElwain, I.B., Orme, L.E., McCraren, J.P., Fowler, L.G., Leonard, J.R. U.S. Department of the Interior, Fish and Wildlife Service, Washington, DC.

5. *Fish Farming Handbook*. (1980). Brown, E.E., Gratzek, J.B. AVI Publishing Co., Inc., Div. Van Nostrand Reinhold, 115 Fifth Ave., New York, NY 1003-1004. (212) 254-3232.

6. *Introduction to Fish Physiology*. (1982). Smith, L.S. T.F.H. Publications, Inc., 211 W. Sylvania Ave., P.O. Box 427, Neptune, NJ 07753.

7. *Water Re-Use Systems*. Rosati, Ronald. Department of Agriculture, Illinois State University. (Presented at the 1990 Illinois Aquaculture Industry Association Convention, January 9, 1990, Decatur, IL.)

8. *Specialty Animal Production Curriculum Guide for Vocational Agriculture/Agribusiness* (#1806). Dept. of Education, Office of Vocational Education, Box 94064, Baton Rouge, LA 70804-9064.

Videos:

9. *The Delta Pride Story*. (15 min). Larry Joiner, Delta Catfish Processors, Inc., Box 850, Indianola, MS 38751. (601) 887-5401.

10. *Redfish*. (15 min). Mike Murphy, Manager. Mississippi State University and Mississippi Power Co., Coastal Aquaculture Unit, Box 7983, Gulfport, MS 39506. (601) 896-5778.

11. *Automatic Feed System*. (10 min). Beverly Hoisington, President, AKVA America, Inc., 631 S. Main, Suite 300, Plymouth, MI 48170. (313) 453-1706.

12. *2132 Packaging System*. (4 min). Wyn Hardy, Director of Fish Packaging, Cryovac Div. of W.R. Grace Co., Duncan, SC 29334. (800) 845-3456.

13. *Crawfish Documentary*. (10 min). Karl Turner, Executive Director, Louisiana Seafood Marketing and Promotion Board, P.O. Box 15570, Baton Rouge, LA 70895. (800) 222-4017.

14. *Crawfish — A Public Television Production*. (27). Bryce Malone, Louisiana Department of Agriculture, Box 44184, Baton Rouge, LA 70804. (504) 295-8416.

15. *Redfish Spawning*. Robert Hunt, The Redfish Hatchery, 23707 Redfish Lane, Pass Christian, MS 39571. (601) 452-2034.

16. *Fish Production: "Net Production" and "Closed System'"* (Two videos). Sidney Corbin, Corbin Fish Farms, Route 1, Towanda, KS 67144. (316) 775-2621.

17. *Catfish Processing*. Ted Dorsa, Gulf South Fish Sales, P.O. Box E, Roseland, LA 70456. (504) 748-5127.

An assortment of other videos on several related aquaculture subjects are available from Fish Farming Experiment Station, P.O. Box 860, Stuttgart, AR 72160. (501) 673-8761.

*Indicates highly recommended reference

INSTRUCTIONAL RESOURCES

These resources are intended for use by teachers in planning and teaching the materials for this problem area and may be adapted to fit the teaching method(s) used.

INFORMATION SHEET #1 — Fish Stress

INFORMATION SHEET #2 — Water Quality Measurements Important in Catfish and Minnow Production

INFORMATION SHEET #3 — Water Quality Testing Considerations

INFORMATION SHEET #4 — Management of Water Quality Problems

INFORMATION SHEET #5 — Carbon Dioxide

INFORMATION SHEET #6 — Ammonia and Nitrites

INFORMATION SHEET #7 — Chlorides

INFORMATION SHEET #8 — Common Water Quality Problems with Catfish and Baitfish Culture

INFORMATION SHEET #9 — Here's How to Help Your Specialist Diagnose Your Troubled Fish

INFORMATION SHEET #10 — Harvesting, Holding, Transporting, and Stocking

INFORMATION SHEET #11 — Shipping Capacities

INFORMATION SHEET #12 — Weights in Relation to Total Length

TRANSPARENCY MASTER #1 — Ichthyophthiriasis (Ich) (with discussion guide)

TRANSPARENCY MASTER #2 — Fish Grubs (Larval Flukes) (with discussion guide)

TRANSPARENCY MASTER #3 — Anchor Parasite (with discussion guide)

TRANSPARENCY MASTER #4 — Fungus (with discussion guide)

TRANSPARENCY MASTER #5 — Decision Process for Treating Fish Health Problems (with discussion guide)

TRANSPARENCY MASTER #6 — U.S. Supply of Edible Fish (with discussion guide)

TRANSPARENCY MASTER #7 — Why Fish? (with discussion guide)

TRANSPARENCY MASTER #8 — Aquaculture Markets (with discussion guide)

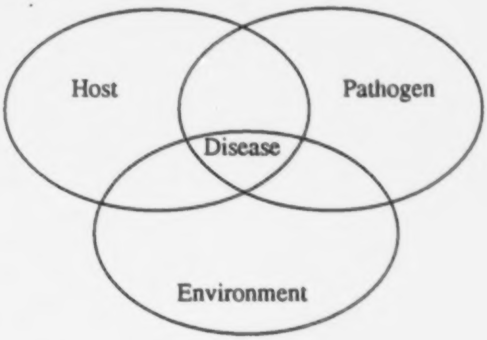
TRANSPARENCY MASTER #9 — Marketing Strategy (with discussion guide)

INFORMATION SHEET #1

Fish Stress

The management of fish is primarily concerned with the management of stress. Fish live in an aqueous environment that is 800 times more dense than that environment in which we live, and deviations from the "natural" conditions in which the species is found will cause "stress." Management attempts to reduce stress, or unnatural conditions, as much as is practical. Because the environment is aqueous, it naturally follows that all the factors associated with water are of prime concern in providing as optimal environment as possible. Water quality factors such as temperature; pH; acidity; alkalinity; levels of ammonia, chloride, nitrite, oxygen, carbon dioxide; and hardness are among the parameters that need to be monitored. In addition, considerations of size, age, species, reproductive status, culturing practice, feeding rate, and stocking densities will interact upon the water quality factors varying the inputs in order to provide the optimal levels required. For example, catfish will lose production efficiency at a dissolved oxygen (DO) level of four percent, whereas trout will lose production efficiency at a DO level of six percent; and this is but one factor.

The results of stress, beyond loss of productive capacity, can be seen in the diagram:



It is estimated that 80 percent of disease comes from stress. Since the pathogens are normally present at a tolerable level, and the host (fish species) is fixed, it is clear that the environmental conditions present will directly influence the toll that the pathogens take. Any lessening of environmental conditions below accepted limits will produce stress on the host and make it more susceptible to attack. A good example is the effect of water depth on pressure. The pressure encountered in 16 ½ feet of water is the same as we feel with a rise of 20,000 feet. This means that a fish going up and down in 3 ½ feet of water feels the same difference we do in going up and down one mile in height. We have heard (or experienced) the accommodations one must make in going to Denver to deal with the atmospheric differences. When one combines the pressure differences with the fact that fish have a maximum of 10 ppm (as opposed to our 200,000 ppm) of oxygen from which to draw that needed for metabolic activity, it is easy to see the difficulties. Even though these conditions are the fish's "natural" environment, respect for the intensity of the interactions leads to the necessity of maintaining as optimal conditions as possible to reach the objectives of the production. An additional factor is that evidence of stress may not be immediately available. An example is an electrical outage that shuts off aerating pumps and leads to a temporary oxygen shortage. It may be 5 to 14 days before a disease may appear that leads the producer to the conclusion, after investigation, that an oxygen shortage has occurred.

The recognition of common symptoms exhibited by sick fish is necessary to prevent large kills that might have been avoided. Some symptoms include the following:

1. Abnormal behavior — Gathering in observable locations, rubbing on structures or plants, sideways swimming.
2. Reduced vitality — Not actively swimming away from disturbances.
3. Reduced feeding activity — Failure to feed vigorously. Emaciation, sunken bellies, and tight skin are indications.
4. Obvious Maladies — Dead or dying fish; open lesions or sores; pale, eroded, puffy, or bloody gills; bloated (fluid-filled) belly; sloughing of the skin; nodules, pustules, or white spots on the skin; white fungus patches; frayed or eroded fins or tail; red spots near the bases of fins; and various dirty grayish or yellowish or foul-smelling lesions.

The best control of disease is prevention. Healthy, vigorous fish will ward off most diseases that occur. An aid in providing the water management and nutrition needed is to anticipate problems that normally occur, such as those related to the time of year. The following give examples of expected season-related occurrences:

Winter

1. Low oxygen levels.
2. High carbon dioxide levels.
3. Ammonia buildup.

4. Temperature fluctuations. A 10-12 degree temperature difference in the water two times in two weeks or three times in a month can prime fish for disease problems.

5. Fungus. In fungal infections, the fungus assumes the color of materials suspended in the water.

Summer

1. Low oxygen levels.

2. High carbon dioxide levels.

3. High hydrogen sulfide after seining.

4. High bacterial activity.

Fall and Spring

1. Bacteria and parasite activity.

2. High nitrites.

3. Fluctuating temperature (see winter).

4. Inadequate feed. Feed as early as possible; increase protein and Vitamin C.

The maintenance of environmental factors to those preferred by the target species will lessen the need for fish to expend energy for adaptation, and thus reduce stress. Not only will the species and the enterprise be more productive, but also the need for remedial expenses and activities to combat diseases and parasites will be reduced.

INFORMATION SHEET #2

Water Quality Measurements Important in Catfish and Minnow Production

Andrew J. Mitchell
U.S. Fish and Wildlife Service
Fish Farming Experimental Laboratory
Stuttgart, Arkansas 72160-0860

Alkalinity and Chlorides

Check three weeks after pond is filled and again if a large volume of water (well, rain, runoff, etc.) has been added to the pond. Alkalinity should be at least 40 ppm, better if above 70 ppm. Chlorides should be at least 30 ppm, better if above 50 ppm. For safe, effective copper sulfate treatments the total alkalinity level must be determined. Alkalinity is also important for carbon dioxide determinations.

Dissolved Oxygen

Check early in the morning as needed. Oxygen levels should be maintained at 4 ppm and above. Low oxygen problems primarily occur in the summer between midnight and dawn.

Temperature

Check as needed. Temperature checking is important in determining toxic levels of ammonia and carbon dioxide.

pH

Check once weekly whenever a water quality problem is suspected. Fish die at pH readings below 4.5 or above 11.0. Best range is pH 6 to pH 9.5. Checking of pH is important in determining toxic levels of ammonia and carbon dioxide.

pH less than 7.5

Carbon Dioxide

Check early morning. Above 35 ppm is a high pond reading. In tanks with golden shiners, the levels should not exceed 20 ppm. Toxic carbon dioxide problems that usually occur in the summer are often associated with low dissolved oxygen.

Nitrites

(For comments see Nitrites in pH above 7.5.)

Hydrogen Sulfide

Check if pH is less than 6.5. Any measurable amount is too much—usually associated with the seining of fish in older ponds.

pH above 7.5

Ammonia

Fish may die when unionized or toxic ammonia levels reach 0.05 ppm for a few weeks or when levels reach 0.4 ppm for a few days. The occurrence of high ammonia readings is correlated to crowded and heavily-fed ponds and the warmer months of the year.

Nitrites

This is important when raising catfish and chlorides are less than 50 ppm. Check every two days if nitrite exceeds 0.05 ppm and chlorides are less than 50 ppm. Fish should be considered in stress if the ratio of chlorides to nitrites is less than 7:1. Brown blood disease caused by high nitrites usually occurs in the spring and fall. Bait minnows rarely, if ever, experience nitrite kills in ponds.

Miscellaneous Measurements

Iron

It is usually a problem in vats or small ponds receiving large quantities of well water. A level of 0.1 ppm can harm fry. Fish are harmed if they are exposed to 0.5 ppm to 1 ppm for several days to a week. Fish may die if exposed to levels above 1 ppm for two to three days.

Hardness

It is of concern when hatching fish eggs. Calcium hardness levels should exceed 5 ppm. To get a good phytoplankton bloom, hardness levels of 20 ppm or greater are desirable.

INFORMATION SHEET #3

Water Quality Testing Considerations

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Fish Farming Experimental Laboratory
Stuttgart, Arkansas 72160-0860

Human Health

It is best not to inhale or touch any dry chemicals or solutions used in water testing. Use tube caps and not fingers for stoppers when mixing is required.

Solutions

All solutions should be replaced every two years. The chloride solution (silver nitrate-Hach) and the ammonia solution (Nesslers reagent-Hach) should be replaced every year. The carbon dioxide solution (sodium hydroxide-Hach) should be replaced at least every six months.

Reagents

Any powdered reagents should be replaced when they discolor or when they cake and are no longer free flowing.

Supplies

Replace Hach pH color wheel every three years. Keep all color wheels in the dark when not in use. Buy extra glass tubes (Hach) as they are easily broken and no extras come in the kits.

Problems and Considerations

The carbon dioxide titration test (Hach) end point is hard to read. When the pink color holds for 20 seconds the end point has been reached.

For most alkalinity measurements (Hach), steps 2 - 5 can be skipped. When the pH is 9.0 or above, then the hydroxide alkalinity (steps 2 - 5) should be determined. Copper sulfate treatments should then be based on the total alkalinity minus the hydroxide alkalinity.

When determining chloride levels with the Hach titration method, count the number of drops needed to change the solution from yellow to orange, then subtract one drop. Multiply this number times the ppm/drop.

When determining the ammonia and nitrite levels don't overlook the multiplication factors given in the directions. In hard water (over 100 ppm), Rochelle salt must be used in the ammonia test (Hach). Find a good background for viewing the Hach ammonia color disk and use the same background for all readings.

One of the most efficient kits for determining an occasional oxygen level is the Chemistries Model 0-12 Dissolved Oxygen Test Kit. For fish cultural situations where oxygen measurements are often taken, a quality oxygen meter is needed.

536

INFORMATION SHEET #4

Management of Water Quality Problems

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Fish Farming Experimental Laboratory
Stuttgart, Arkansas 72160-0860

Water Quality Problem	Treatment	Comments
Low alkalinity	Calcium hydroxide (hydrated lime)*	Add 20-50 lbs/surface acre then check alkalinity level.
	Sodium bicarbonate	About 3.7 lbs/acre-foot will increase the alkalinity one ppm.
	Agricultural limestone	Apply at 1-2 ton/acre to dry pond bottom. For more accurate application rates determine the soil lime requirement every 2-3 years.
Low chlorides	Sodium chloride (salt)	4.5 lbs/acre-foot of salt will increase the chlorides one ppm.
	Calcium chloride (anhydrous)	4.3 lbs/acre-foot will increase the chlorides one ppm.
Low-dissolved oxygen	Aerate	Aerate until oxygen levels reach 4 ppm.
	Fertilize	May help if bloom is gone.
High pH	Sodium bicarbonate	Add up to 200 lbs/surface acre, then check pH. Limited effectiveness in ponds with alkalinity over 100 ppm.
	Gypsum*	Add 50-100 lbs/surface acre, then check pH.
	Alum*	Add 25-75 lbs/surface acre, then check.
Low pH	Sodium bicarbonate	Add up to 200 lbs/acre, then check.
	Calcium hydroxide*	Add 20-50 lbs/acre, then check.
High ammonia levels	Pump water	Pond or well water may provide a small area of acceptable water to the stressed fish.
	Fertilize	May help if bloom is light.
	Lower pH	See comments for high pH. Not practical in water with high alkalinity.
High nitrite levels	Calcium chloride	See rates above. For best results keep chloride to nitrite levels at 15:1.
	Sodium chloride	See rates above.
High carbon dioxide levels	Calcium hydroxide*	About 2.7 lbs/acre-foot to remove 1 ppm carbon dioxide.
	Aerate	This is only useful if oxygen levels are low.
Hydrogen sulfide poisoning	Potassium permanganate	Put about 5 ppm in areas of net landing.
High iron levels	Aerate and filter or settle	The level of aeration, filtration, or settlement is dependent on water flow and iron level in water.
	Potassium permanganate	Apply 2-5 ppm in tanks depending on fish species. In ponds, the rate depends on the organic buildup.
Low Hardness	Calcium chloride	See rates above.
	Calcium hydroxide*	About 3.9 lbs gives 1 ppm lime/acre-foot.

*If the total alkalinity is less than 40 ppm it is best not to use this chemical.

INFORMATION SHEET #5

Carbon Dioxide

Carbon Dioxide Producers

1. Fish — moderate
2. Microscopic organism in water (night) — heavy
3. Bottom mud organisms — light
4. Chemically produced when pH is lowered
   Carbonates → Carbon Dioxide + Oxygen

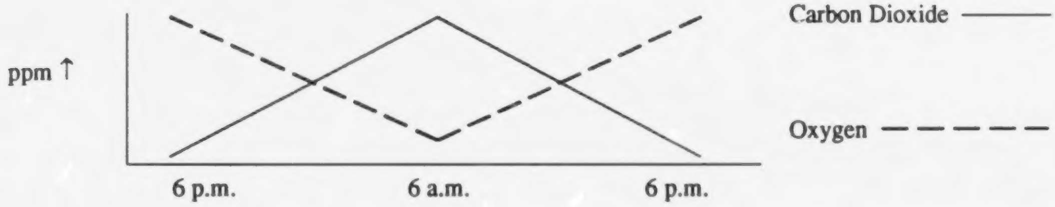
Carbon Dioxide Users/Loss

1. Microscopic organisms in water remove large quantities of carbon dioxide during the day.
2. Carbon dioxide is lost to the atmosphere.
3. Rise in pH converts carbon dioxide to carbonates.

Toxic Levels

1. Catfish — above 35 ppm (summer)
2. Golden shiners — 20 ppm or more

Daily Cycle - Opposite of Oxygen



Effect on Respiration

Carbon dioxide suppresses oxygen absorption by the fish. The greater the carbon dioxide level present the more the oxygen level must be increased for survival.

Treatment

1. Hydrated lime at 25 lbs/acre-foot treats about ten ppm carbon dioxide.
2. Sodium bicarbonate can raise pH and lower carbon dioxide.
3. Aeration is not very effective.

Miscellaneous

In winter, when temperatures are lower, fish can withstand much higher carbon dioxide levels than in the summer.

INFORMATION SHEET #6

Ammonia and Nitrites

Ammonia

Where — In ponds with:
1. High stocking rates
2. High feeding rates

When — Worst time:
1. Late summer to mid fall
2. Middle to late afternoon

Signs

Acute toxicity:
1. Skittish or spasmodic fish

Chronic toxicity:
1. Lessened feeding activity
2. Retarded growth

Cause — Nitrogen buildup in ponds:
1. Excess feeds
2. Fish wastes
3. Bloom die-offs
4. Bottom mud metabolism

Toxic Levels

Acute:

Above 0.4 ppm unionized ammonia

Chronic:

Above 0.05 ppm unionized ammonia

Unionized ammonia levels are determined from the total ammonia, using pH and temperature readings with proportion table.

Toxic levels vary with water conditions.

Cure
1. Pump fresh water.
2. If bloom is light use phosphate fertilizers.
3. Lower pH if acute problem occurs.
4. Aerate to maximize oxygen levels.

Prevention
1. Don't overfeed.
2. Cut feeding rate from mid-summer to late summer.
3. Drain and dry ponds yearly if possible.

Nitrites

Where — In ponds with:
1. High stocking rates
2. High feeding rates

When — Worst time:
1. Spring and fall when temperatures fluctuate

What
1. Hemoglobin in the blood is oxidized by nitrite and forms methemoglobin which can't carry oxygen.
2. Fish become oxygen starved.

Signs

Acute toxicity:
1. Brown blood and gills
2. Fish stress at water surface similar to low-oxygen stress

Chronic toxicity:
1. No signs

Cause — Nitrogen buildup in ponds from:
1. Excess feeds
2. Fish wastes
3. Bloom die-offs
4. Bottom mud metabolism

Problem Levels
1. Nitrite toxic level occurs when the ratio of chlorides to nitrites drop to less than 7.1.
2. The brown blood condition occurs when the ration is less than 3:1.
3. Other factors including bicarbonate and sodium levels may cause the chloride/nitrite ratios given above to vary greatly.

Cure
1. Aerate to maximize oxygen levels.
2. Add salt (sodium or calcium chloride) to pond water to bring chloride/nitrite ratios above 7:1.

Prevention
1. Don't overfeed.
2. Cut feeding rate mid-summer to late summer.
3. Drain and dry ponds yearly if possible.
4. Put a base level of at least 30 ppm chlorides in pond water.

INFORMATION SHEET #7

Chlorides

Why are they important?

1. Chlorides offer protection against nitrites.
2. Winter kill of catfish is directly related to low chloride levels in ponds.
3. Ponds with good chloride levels have fewer off-flavor problems.

What levels are desirable?

1. Less than 30 ppm — not desirable
2. 31 to 50 ppm — okay
3. 51 to 2,000 ppm — good
4. Above 2,000 — may be toxic to some fish

How to add chloride to ponds

1. For every part per million needed add:
   4.5 lbs of sodium chloride/acre-foot of water
   4.3 lbs of calcium chloride (anhydrous)/acre-foot of water
   5.6 lbs of calcium chloride (dihydrous)/acre-foot of water

Formula for chloride treatment of a nitrite problem

$(7 \times N) - C$ = Amount of Chloride to add in ppm
N = Nitrites measured
C = Chlorides measured

INFORMATION SHEET #8

Common Water Quality Problems with Catfish and Baitfish Culture

	Spawning	Hatching	Stocking	Growing	Harvest	Pond to Shed	Vat Storage	Commercial Haul
Temperature	B/C	B/C	B/C	B	B/C	B/C	B/C	B/C
Turbidity	B			B				
Alkalinity				B/C			B/C	B/C
Hardness		C						
pH	C			B/C			B/C	B/C
Oxygen		B/C	B/C	B/C	B/C	B/C	B/C	B/C
Carbon Dioxide		B/C	B	B/C			B/C	B/C
Iron		B/C	B	B			B/C	B/C
Ammonia				B/C			B/C	B/C
Nitrite				C			B	
Chloride		C		C				
Chlorine							B/C	
Hydrogen Sulfide			B	B/C	B/C			

B - Baitfish
C - Catfish

Fish Farming Experimental Station
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(501) 673-4483

INFORMATION SHEET #9

Here's How to Help Your Specialist Diagnose Your Troubled Fish

Think of your fish disease specialist as a detective in search of clues — far away from the scene of the murder, far from the scene of the fish kill.

He or she needs all the evidence — the best diseased fish samples — you can provide, as quickly as possible.

Here are some tips from disease specialists at Mississippi State University on how you can provide good fish samples:

1. Send to the specialist the best sample possible, packed in the best manner possible, as soon as you can. Three to ten fish samples are preferred.
2. Call the specialist before you send or carry the sample so that he or she can expect you and your sample.

The best fish samples can be hard to find and harder to catch, but they are worth the time and effort because they offer the best chance of correctly identifying problems in the shortest time.

Excellent Samples

High probability of identifying the problem

1. Live fish which are:
   - Lying lethargically in shallow water and not moving off rapidly when disturbed.
   - Hanging listlessly at the water's surface and not going down quickly when disturbed. Or if they do go down, they return quickly to the surface.
   - Swimming rapidly in a circle or in an erratic manner.
2. Live fish that exhibit:
   - Open sores.
   - Light-colored, slightly eroded areas in front of dorsal fins or other parts of the body.
   - Yellowish areas inside the mouth cavity.
   - Eroded and light areas on gills.
   - Swollen, fused, or clubbed gills.
   - Eroded and hemorrhagic fins.

Fair Samples

Probability of identifying the problem depends on how long the fish has been dead

1. Dead fish that still have red gills and somewhat normal amounts of mucus and color.
2. The longer the dead fish remains in the pond the poorer sample it makes. Tissues begin to break down and normal purifying bacteria attack the fish almost immediately.

Poor Samples

Little probability of identifying the problem

1. Several fish taken at random from the seine sample. Despite the random selection, a majority of the fish in the pond may be healthy.

   Sometimes, however, the number of species of parasites found on the fish might provide an indication of the problem.

2. Live fish caught by hook and line from several different areas of the pond. Healthier fish usually bite more readily than weaker fish, so the hooked fish will likely be free of parasites and pathogenic organisms.

   Occasionally, the sample will provide an indication of the problem by the number and types of pathogenic organisms found, especially if the fish show approximately the same level of infection.

Unusable Samples

No possibility of identifying the problem

1. Dead fish that have lost body color and mucous coat and have white, mushy gills.
2. Water samples from the pond containing diseased fish. A water sample is of little value in determining the cause of a fish kill unless a toxic substance is suspected. If this is the case, collect a one-gallon water sample in a clean glass container and send it along with the fish samples to the disease specialist.

If you intend to treat the pond with a chemical whose toxicity varies with the water hardness, send a water sample along with the fish sample to the specialist.

It is good management, however, to remove all dead fish from your pond each day. This will help to determine how rapidly the loss is increasing and will give you an accurate record of your mortality at the end of the production.

Other Helpful Information

If possible, send this information (along with the fish samples) to the disease specialist:

1. Number of fish lost since the die-off started.
2. Approximate number of fish lost each day.
3. When the losses started (date and time).
4. Number of surface acres per pond (or tank dimensions).
5. Average depth.
6. Number of fish stocked in the pond.
7. The last night the pond was treated (why, what chemical was used, and how much?).
8. Condition of the bloom:
    a. Light — Pond visibility of 18 inches or more; no accumulation of algae in the corners or on the downwind side.
    b. Moderate — Pond visibility of 12 to 15 inches; a moderate amount of algae accumulated in the corners or on the downwind side.
    c. Heavy — Pond visibility of 12 inches or less.

Transporting and Shipping Samples

1. Place live fish in a plastic bag and seal. Place the bag in an ice chest containing crushed ice.
2. If the fish are to be hauled for a short distance, place them in a container or ice chest containing well-oxygenated water. Add a few chunks of ice to keep the water cool.
3. Freeze the fish if there is no other way to keep them from spoiling enroute to the lab. Frozen samples are hard to work with and should be avoided whenever possible. Frozen samples are acceptable if they are for pesticide analysis.
4. Ice down immediately, to retard further tissue breakdown, all dead fish collected but which are still acceptable for examination (red gills, etc.).

INFORMATION SHEET #10

Harvesting, Holding, Transporting, and Stocking

Harvesting

The techniques and procedures used in harvesting can have a profound effect on the success of shipping and the livability of fish once transported. The following guidelines may be helpful.

1. Starve fish one day prior to harvest. Fish disgorge feed consumed recently which adds to water quality problems.
2. Use the techniques which will reduce muddy waters. Muddiness can contribute to off-flavor.
3. Cook and taste a few fish for off-flavor problems.
4. Make sure proper aeration is provided during harvesting and in holding pens.
5. Remove the remaining water from a pond that was drained to facilitate harvest.
6. Harvesting in summer is more difficult than winter. Oxygen deficiencies occur rapidly and tanks can be subject to heating. Trapping may be less stressful than seining.
7. Harvest in winter requires awareness of cold shock (especially smaller fish). Risk as little exposure to chilling as possible.

Methods

Complete — Involves draining a pond or container for removal of all fish.

Partial — Involves removal of fast-growing or larger fish at regular intervals.

Cages, tanks or water reuse systems are adaptable to either method as the situation warrants.

Seining

Use a net to crowd the fish into one end of a pond. The size of mesh used in the seine determines the size of fish held. In hot weather seining should be done during the early morning. After the fish are crowded to one end, bailers are used to load fish into tanks for holding.

Approximate sizes of channel catfish retained by nets of different meshes are given in the table below.

Mesh size (inches, bar measure)	Weight of smallest fish held (pounds)
1	½
1 3/8	¾
1 5/8	1
1¾	1½
2	2

Trapping

Feed is used to draw fish into a seine that is positioned at one end of the pond. After feeding for several days, the ends are pulled to shore and the fish are trapped and bailed.

Grading

To ensure uniformity of size, bars or grading boxes can be used to determine the size of fish that will be held. Examples are given in the table below.

Bar grader sizes for minnows and channel catfish

Fish, and spacing between grader bars, or mesh size of net (inches)	Length of fish held (inches)
Minnows	
Bar grader	
11/64	1½
12/64	1¾
13/64	2
14/64	2¼
15/64	2½
16/64	2¾
Channel Catfish	
Bar grader	
27/64	3
32/64	4
40/64	5
48/64	6
56/64	7
64/64	8
96/64	11

Holding

Due to scheduling or other problems, it may be necessary to hold fish in tanks after harvesting and before shipping. Tanks can be of various materials and may be circular, which are easier to clean, or rectangular, which are easier for harvesting. A typical size is four feet wide, ten feet long, and two feet deep. This size holds about 500 gallons of water and will hold 300 pounds of fish if sufficient aeration and water exchange is provided.

Transporting

Trucks are the main transportation medium for transporting fish, although bags may be used in some instances. Considerations that are of concern are as follows:

1. Tank Design — Most new fish-distribution tanks are constructed of fiberglass or aluminum, but plywood, redwood, stainless steel, glass, galvanized iron, and sheet metal all have been utilized in the past.

   Aluminum is lightweight, corrosion-resistant, and easily mass-produced. Alloys in the range 3003H14 to 6061T6 will not cause water-quality problems.

   Fiberglass is molded easily into strong lightweight tanks and can be repaired readily. Its smooth surface is simple to clean and sanitize. Aluminum and fiberglass appear equally well-suited for fish-transport tanks.

   Most tanks constructed in recent years are insulated, usually with styrofoam, fiberglass, urethane, or corkboard. Styrofoam and urethane are preferred materials because of their superior insulating qualities and the minimal effect that moisture has on them. A well-insulated tank minimizes the need for elaborate temperature-control systems and small amounts of ice can be used to control the limited heat rises.

   Circulation is needed to maintain well-aerated water in all parts of the tank. Transportation success is related to tank shape, water circulation pattern, aerator type, and other design criteria.

   Although most tanks presently in use are rectangular, the trend in recent years has been towards elliptical tanks, such as those used to transport milk. This shape has several advantages.

   a. V-shaped, elliptical, or partially round tanks promote better mixing and circulation of water as the size of the tank increases.
   b. Polyurethane insulation, which has the best insulating qualities, lends itself ideally to a round or oval tank. It can be injected easily within the walls of the tank.
   c. These tanks can be constructed with few structural members and without sharp corners that might injure fish.
   d. Rapid ejection of fish is facilitated by an elliptical tank.
   e. Lowering the water level in these tanks reduces surface area and simplifies the removal of fish with dip nets. The rounded bottom also contributes in this respect.
   f. As this shape of tank is widely used by bulk liquid transport companies, they are mass-produced and readily available.
   g. This shape conforms to a truck chassis and holds the center of gravity towards the area of greatest strength.
   h. Construction weight is less than that of rectangular tanks of the same capacity.

2. Circulation — Circulation systems are of various sizes and designs; all have plumbing added for the pickup and discharge of water. Suction lines to the pumps lie on the bottom of the tank and are covered by perforated screens. Water is carried to the pumps and then forced through overhead spray heads mounted above the waterline. In most systems, oxygen is introduced in one of the suction lines just ahead of the pump. This usually is controlled by a medical gas-flow meter; because of the danger involved in handling and transporting bottled oxygen, care must be taken to follow all prescribed safety procedures.

   The advantages of aerator systems over gasoline-driven water pump systems are:

   a. Temperature increases from aerators are less than 1 degree F per hour, compared with 2.5 degrees F with pumps.
   b. Aerators and the oxygen injection system can operate independently. There are advantages to carrying small sizes of certain species of fish on oxygen alone. Oxygen also can be used as a temporary backup system if aerators fail.
   c. Usually, aerators have fewer maintenance problems.
   d. Costs of recirculating equipment and aerators strongly favor aerators.

e. Use of aerators eliminates the space required between the tank and truck cab for pumps and plumbing, so the overall truck length can be reduced to assure safer weight distribution. The empty weight of a truck with a 1,250-gallon tank equipped with aerators is 14,000 pounds or 2,000 pounds less than a similar unit operating with pumps and refrigeration.

The most efficient tanks have the highest water circulation rates, but circulation rates must be balanced with water capacity. Pumping or aerating systems should be able to circulate at least 40 percent of the tank water per minute when 8- to 9-inch salmonids are hauled, though lesser rates are appropriate for smaller fish.

3. Aeration — The purpose of aeration during transport is to provide oxygen and to reduce the concentration of carbon dioxide. The exchange of gases between water and the atmosphere is a recognized and important problem in transporting fish. Transport water must contain adequate oxygen, pH levels must remain within a tolerable range, and toxic levels of dissolved ammonia and carbon dioxide must be suppressed. A partial solution to this complex problem is aeration by sprays, baffles, screens, ventri units, compressed gas liberation, agitators, or air blowers. Bottled gaseous or liquid oxygen is liberated within tanks in a variety of ways, including perforated rubber tubing, Carborundum stones, carbon rods, and micropore tubing, or is injected directly into the recirculation system.

The formation of scum and foam on the surface of transport water may result from drug usage or excessive mucus produced by large numbers of fish hauled over long distances. Excessive foaming interferes with observation of fish during transit and inhibits aeration. To alleviate this problem, a ten percent solution of Dow Corning's Antifoam AF emulsion should be used at the rate of 25 milliliters per 100 gallons of water. For maximum effectiveness, the compound should be mixed in before drugs are added or fish loaded. Antifoam is non-toxic to fish.

4. Water Quality

a. Oxygen — The most important single factor in transporting fish is providing an adequate level of dissolved oxygen. However, an abundance of oxygen within a tank does not necessarily indicate that the fish are in good condition. The ability of fish to use oxygen depends on their tolerance to stress, water temperature, pH, and concentrations of carbon dioxide and metabolic products such as ammonia.

The importance of supplying sufficient quantities of oxygen to fish in distribution tanks cannot be overemphasized. Failure to do so results in severe stress due to hypoxia and a subsequent buildup of blood lactic acid, and may contribute to a delayed fish mortality. Ample oxygen suppresses harmful effects of ammonia and carbon dioxide. Dissolved-oxygen content of transport water preferably should be greater than seven parts per million, but less than saturation. Generally, as long as the oxygen concentration is at least six parts per million, salmonids have ample oxygen; however, should carbon dioxide levels increase, more oxygen is required by the fish. Oxygen consumption by fish increases dramatically during handling and loading into the transportation tank. For this reason, additional oxygen (as much as twice the flow normally required) should be provided during loading and the first hour of hauling. The oxygen flow can be reduced to normal levels (to provide six parts per million in the water) after this acclimation period, when the fish have become settled and oxygen consumption has stabilized.

The addition of certain chemicals such as hydrogen peroxide has been effective in increasing the oxygen concentration in water. However, a more practical and economical method is to introduce oxygen directly from pressurized cylinders into the circulating water.

Control of water temperature, starving fish before they are transported, and the addition of chemicals and anesthetics to the water have reduced hauling stress.

b. Temperature — Insulation and ice have been used to control the temperature of transport water. Ice sometimes is difficult to find during a delivery trip and can cause damage to fish and tanks if used in large pieces. The main advantage of ice is its simplicity; it involves no mechanical refrigeration equipment that can break down.

c. Ammonia — When fish are transported in distribution tanks, their excretory products accumulate in the water. Ammonia is the main metabolic product of fish and is excreted through the gills. Total ammonia concentrations can reach ten parts per million (ppm) or higher in fish distribution tanks depending on the fish load and duration of the haul. Exposure to 11 to 12 ppm total ammonia (0.13 to 0.14 ppm unionized ammonia) for six hours and longer adversely affects trout and can reduce stamina.

Temperature and time of last feeding are important factors regulating ammonia excretion. For example, trout held in water at 34 degrees F excrete 66 percent less ammonia than those held in 51 degrees F water, and fish starved for 63 hours before shipment produce half as much ammonia as recently fed fish. Small fish should be starved for at least two days prior to shipping. Fish larger than four inches should be starved at least 48 hours; those eight inches and larger should be starved 72 hours. If they are not, large losses may occur.

Water temperature during shipping should be as low as can be tolerated by the fish being handled. Low temperatures not only reduce ammonia production, but oxygen consumption as well.

d. Carbon Dioxide — Elevated carbon dioxide concentrations are detrimental to fish and can be a limiting factor in fish transportation. A product of fish and bacterial respiration, carbon dioxide acidifies transport water. Although this reduces the percentage of unionized ammonia in the water, it also reduces the oxygen-carrying capacity of fish blood. Fish may succumb if carbon dioxide levels are high, even though oxygen levels are seemingly adequate. Trout appear to tolerate carbon dioxide at levels less than 15.0 ppm in the presence of reasonable oxygen and temperature, but become distressed when carbon dioxide levels approach 25.0 ppm.

Fish transported in distribution tanks are exposed to gradually increasing concentrations of carbon dioxide. Unless aeration is adequate, carbon dioxide levels may exceed 20-30 ppm. In general, for each milliliter of oxygen a fish consumes, it produces approximately 0.9 milliliters of carbon dioxide. If the carbon dioxide level increases rapidly, as with heavy fish loads, fish become distressed. However, elevated concentrations of carbon dioxide can be tolerated if the rate of buildup is slow.

Adequate ventilation, such as air scoops provide, is a necessity for distribution units. Tight covers or lids on the units can result in a buildup of carbon dioxide which will stress the fish. Aeration of the water will reduce concentrations of dissolved carbon dioxide, if there is adequate ventilation. As mentioned previously, antifoam agents reduce foaming, which inhibits aeration and contributes to the buildup of carbon dioxide.

e. Buffers — Rapid changes in pH stress fish, but buffers can be used to stabilize the water pH during fish transport. The organic buffer trishydroxymethylaminomethane is quite effective in fresh and salt water. It is highly soluble, stable, and easily applied. This buffer has been used on 29 species of fish with no deleterious effects. Levels of 5-10 grams per gallon are recommended for routine transport of fish. The least promising buffers for fish tanks have been inorganic compounds such as phosphates.

5. Stress — Stress associated with loading, hauling, and stocking can be severe and result in immediate or delayed mortality. When fish are handled vigorously while being loaded into distribution units, they become hyperactive. They increase their oxygen consumption and metabolic excretion. The first hour of confinement in the unit is critical. Oxygen consumption remains elevated for 30 - 60 minutes then gradually declines as fish become acclimated. If insufficient oxygen is present during this adjustment period, fish may develop an oxygen debt. The problem may be alleviated if oxygen is introduced into the distribution tank 10 to 15 minutes before fish are loaded, especially if the water has a low dissolved oxygen content. When fish are in the unit, the water should be cooled. After the first hour of the trip, the oxygen flow may be gradually decreased, depending on the condition of the fish.

The total hardness should be raised in waters used to hold fish during handling and shipping. The addition of 0.1-0.3 percent salt and enough calcium chloride to raise the total hardness to 50 ppm is recommended for soft waters. Calcium chloride need not be added to harder waters, which already contain sufficient calcium.

6. Anesthetics — Experimentation with anesthetics and their effects on fish was most active during the 1950s. The main benefit of anesthetics is a reduction in the metabolic activity of fish, which results in lower oxygen consumption, less carbon dioxide production, and reduced excretion of nitrogenous wastes. Such drugs made it possible to transport trout at two to three times the normal weight per volume of water. Their tranquilizing effects also reduce injury to large or excitable fish when they are handled.

7. Carrying Capacity — The weight of fish that can be safely transported in a distribution unit depends on the efficiency of the aeration system, duration of the haul, water temperature, fish size, and fish species.

   If environmental conditions are constant, the carrying capacity of a distribution unit depends upon fish size. Fewer pounds of small fish can be transported per gallon of water than of large fish. It has been suggested that the maximum permissible weight of trout in a given distribution tank is directly proportional to their length. Thus, if a tank can safely hold 100 pounds of two-inch trout, it could hold 200 pounds of four-inch trout, and 300 pounds of six-inch trout.

   Reported loading rates for fishes vary widely among hatcheries, and maximum carrying capacities of different types of transportation units have not been determined.

   Fish loadings have been calculated and reported inconsistently. In the interests of uniform reporting by fish culturists, it is suggested that loading densities be calculated by the water-displacement method. This is based on the actual volume of the distribution tank being used, the weight of fish being transported, and the volume of water displaced by the fish.

   Table 3 provides the water displacements for various weights of fish. As an example, what would be the loading density of 800 pounds of fish transported in a 500-gallon tank?

$$\text{Loading density} = \frac{\text{pounds of fish}}{\underset{(gallons)}{\text{tank capacity}} - \underset{(gallons)}{\text{water displaced by fish}}}$$

(pounds per gallon)

$$\text{Loading density} = \frac{800}{500 - 96}$$

Loading density = 1.98 pounds per gallon

Stocking

It has been an established practice to acclimate fish from the temperature of the transportation unit to that of the environment into which they are stocked, a process called tempering. In the past, temperature was the main reason given for tempering fish. There is some doubt, however, that temperature is the only factor involved. Evidence in many cases has failed to demonstrate a temperature shock even though there was a difference of as much as 30 degrees F; changes in water chemistry and dissolved gas levels may be more important than temperature changes. The fish may be subjected to carbon dioxide and oxygen tensions in the shipping water that are not present in the natural environment. Osmotic shock can be a very serious problem, particularly if fish reared in hatcheries with buffered water from limestone formations are stocked into dilute acidic waters.

Addition of receiving water to the fish distribution tank before fish are unloaded requires effort, but the benefits will more than justify the effort in many situations. As fish are gradually changed from hauling water to receiving water, they have an opportunity to make some adjustments to their future environment. Flowing water also aids in removing fish from the tank with minimum stress.

Table 3 — Approximate Amount of Water Displaced by a Known Weight of Fish. All figures rounded to nearest whole number. (Source: McCaren and Jones 1978)

Weight of Fish (lb)	Water Displaced (gal)	Weight of Fish (lb)	Water Displaced (gal)
100	12	2,100	252
200	24	2,200	264
300	36	2,300	276
400	48	2,400	288
500	60	2,500	300
600	72	2,600	312
700	84	2,700	324
800	96	2,800	336
900	108	2,900	348
1,000	120	3,000	360
1,100	132	3,100	372
1,200	144	3,200	384
1,300	156	3,300	396
1,400	168	3,400	408
1,500	180	3,500	420
1,600	192	3,600	432
1,700	204	3,700	444
1,800	216	3,800	456
1,900	228	3,900	468
2,000	240	4,000	480

INFORMATION SHEET #11

Shipping Capacities

Pounds of black bass or sunfishes that can be transported per gallon of water at temperatures of 65 to 85°F.[a]

Weight of fish (number per pound)	Total Length (inches)	Approx. number per gallon	Pounds per gallon
25	4	25	1.00
100	3	67	0.66
400	2	200	0.50
1,000	1	333	0.33

Capacity (normal) load in pounds of fish per gallon of water for transportation by the tank method (with agitators or blower system) of fish in good condition in hard water at 65°F.[a]

Type of fish and average length (inches)	Duration of transport (hours)			
	1	6	12	24
Fingerling food fish				
2	2	1½	1	1
8	3	3	2	1½
Adult food fish				
14	4	4	3	2
Baitfish				
2	2	1½	1	1
3	3	2	1	1

Estimated pounds of channel catfish that can be hauled per gallon of water per unit of transportation time at 65°F.[a]

Weight of fish (number per pound)	Transit period (hours)		
	8	12	16
1	6.30	5.55	4.80
2	5.90	4.80	3.45
4	5.00	4.10	2.95
50	3.45	2.50	2.05
125	2.95	2.20	1.80
250	2.20	1.75	1.50
500	1.75	1.65	1.25
1,000	1.25	1.00	0.70
10,000	0.20	0.20	0.20

[a] The loading rate can be increased by 25 percent when pure oxygen is added. For each 10°F increase in water temperature, the loading should be decreased by 25 percent.

Carrying capacity (in pounds) of fish in 18- by 32-inch plastic bags containing two gallons (~ 15 lb.) of water at 65°F.[b]

Stage or (for fingerlings) total length in inches	Duration of transport (hours)			
	1	12	24	48
Eggs	1.0 - 3.0	1.0 - 2.5	1.0 - 2.0	0.5 - 1.0
Fry				
Yolk-sac	2.0 - 6.0	1.4 - 5.0	0.8 - 4.0	0.2 - 2.0
Swim-up	1.0 - 4.0	0.9 - 3.2	0.8 - 2.5	0.4 - 1.3
Fingerlings				
½	1.8 - 6.0	1.5 - 5.0	1.2 - 4.0	0.6 - 2.0
1	2.0 - 7.0	1.7 - 6.0	1.3 - 5.0	0.7 - 2.5
2	2.0 - 8.0	1.8 - 7.0	1.5 - 6.0	0.7 - 3.0
3	2.0 - 8.0	1.8 - 7.0	1.5 - 6.0	0.7 - 3.0
Large fish	4.0 - 10.0	3.0 - 7.5	2.0 - 5.0	1.0 - 2.5

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[b] Before transporting fish, it is imperative that the shipper package trial boxes of fish and subject them to the extremes of temperature and anticipated time enroute to the destination. An experienced shipper provides a sizable safety factor in loading weight to allow for delays enroute and exposure to heat.

INFORMATION SHEET #12

Weights in Relation to Total Length

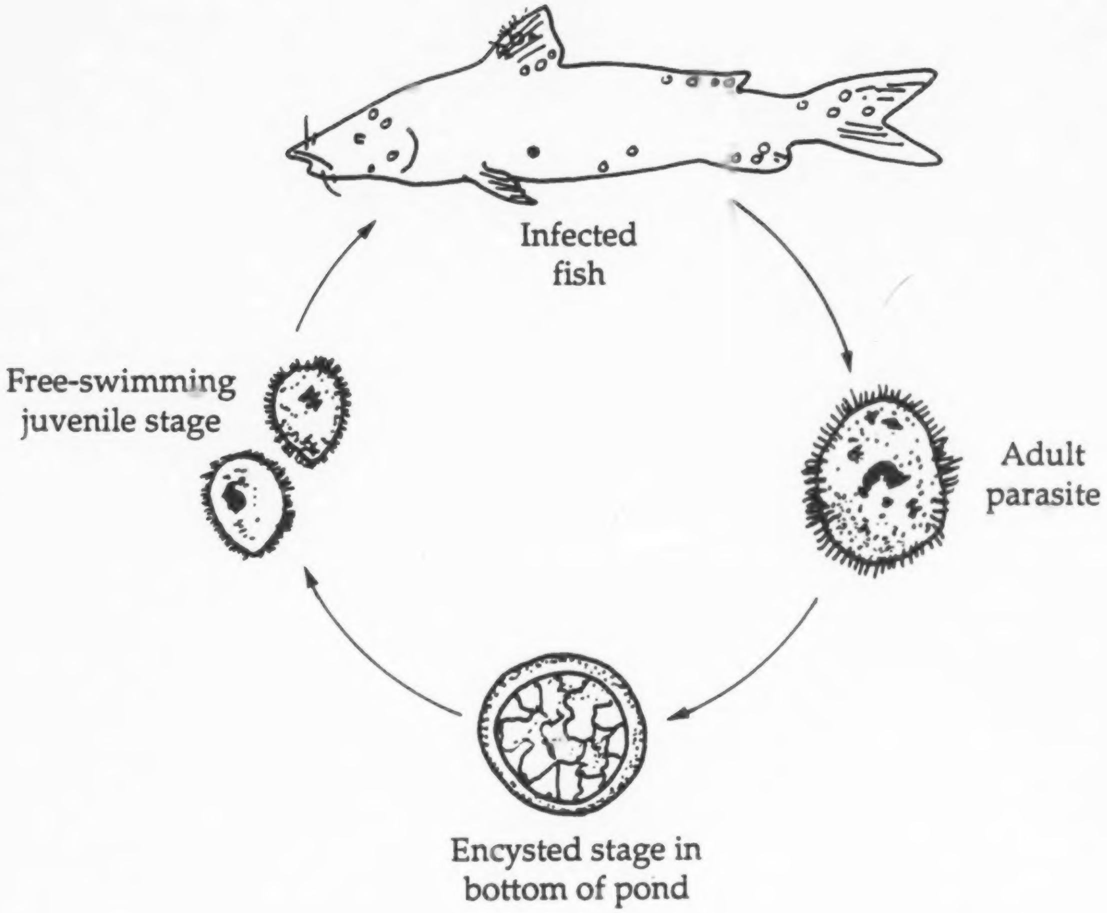
Weight (pounds) of 1,000 fish of different species, in relation to total length.

TL	Families and species																		
	Catfishes			Sunfishes						Suckers		Carps and minnows					Others		
(in.)	CC	BL	FC	LB	BG	RS	GS	BC	WC	SB	BB	CC	GF	GS	FM	RS	RT	TS	WB
2		2.8	3.3	3.5	5.0	5.4	5.2	3.7	3.5	4.1		7.6	5.4	3.9	3.3	2.5	3.2	3.0	
2 ½	4.6	5.4	6.3	7.0	9.8	10.1	10.1	7.2	7.0	8.1		13.7	9.0	5.4	7.6	4.6	5.1	5.8	7.8
3	7.7	9.0	10.7	12.3	17.2	17.6	17.4	12.2	11.8	14.0	16.2	22.2	17.0	8.6	11.0	8.8	8.8	9.6	13.3
3 ½	12.3	14.3	16.7	19.8	28.6	27.8	27.7	19.3	19.8	22.4	25.7	33.4	24.5	13.5	19.8		17.6	14.9	20.8
4	18.3	21.0	24.6	29.7	41.4	41.1	41.3	28.6	29.6	33.7	38.3	47.4	40.0	19.0	24.4		25.6	21.8	31.0
4 ½	26.0	29.9	34.6	42.9	59.5	58.2	59.9	40.6	42.4	48.2	54.2	64.6		31.5	28.3		35.0	29.9	44.3
5	35.2	40.7	46.9	59.0	82.4	79.5	81.9	55.7	58.4	66.3	74.2	85.0		44.0			63.9	40.3	60.6
5 ½	46.9	53.7	61.9	78.8	110	106	109	73.9	78.2	88.6	98.3	109		60.0				52.2	80.5
6	60.5	69.8	79.3	103	144	136	141	95.6	102	116	127	137					104		104
6 ½	76.4	88.1	100	132	185	173	179	121	130			167							132
7	95.2	110	139	165	234	215	223	151	163			206					174		165
7 ½	117	134	152	204	286	264	273	186	200			247							203
8	141	162	183	248	352	320	331	228	245			293					218		246
8 ½	168	194	218	299	416	383	396	269	295			344							294
9	199	229	257	354		453		321	351			399					328		349
9 ½	233	269	303	420		532		375	414			460							410
10	272	312	350	491		619		436	484			527					449		478
11	376	414	471	657				573	648			677					535		635
12	501	532	618	857					845			851					681		823
13	654	680	801	1,094					1,078			1,050					868		1,045
14	834	872	1,014	1,373					1,351			1,276					1,086		1,303
15	1,048	1,100	1,263	1,695					1,688			1,574					1,330		1,610
16	1,297	1,366	1,558	2,073					2,031			1,903					1,674		1,940
17	1,585	1,674	1,880	2,484								2,296					2,049		2,324
18	1,914	2,029	2,255	2,958								2,747					2,335		
19	2,709	2,891	3,152	4,082								3,233					2,910		
20	2,709	2,891	3,152	4,082								3,776					3,267		
22	3,183	3,414	3,717	4,738								4,401					3,634		

Abbreviations follow in the order shown, left to right. Catfishes: CC, channel catfish; BL, blue catfish; FC, flathead catfish. Sunfishes: LB, largemouth bass; BG, bluegill; RS, redear sunfish; GS, green sunfish; BC, black crappie; WC, white crappie. Suckers: SB, smallmouth buffalo; BB, bigmouth buffalo. Carps and minnows: CC, common carp; GF, goldfish; GS, golden shiner; FM, fathead minnow; RS, red shiner. Others: RT, rainbow trout; TS, threadfin shad; WB, white bass.

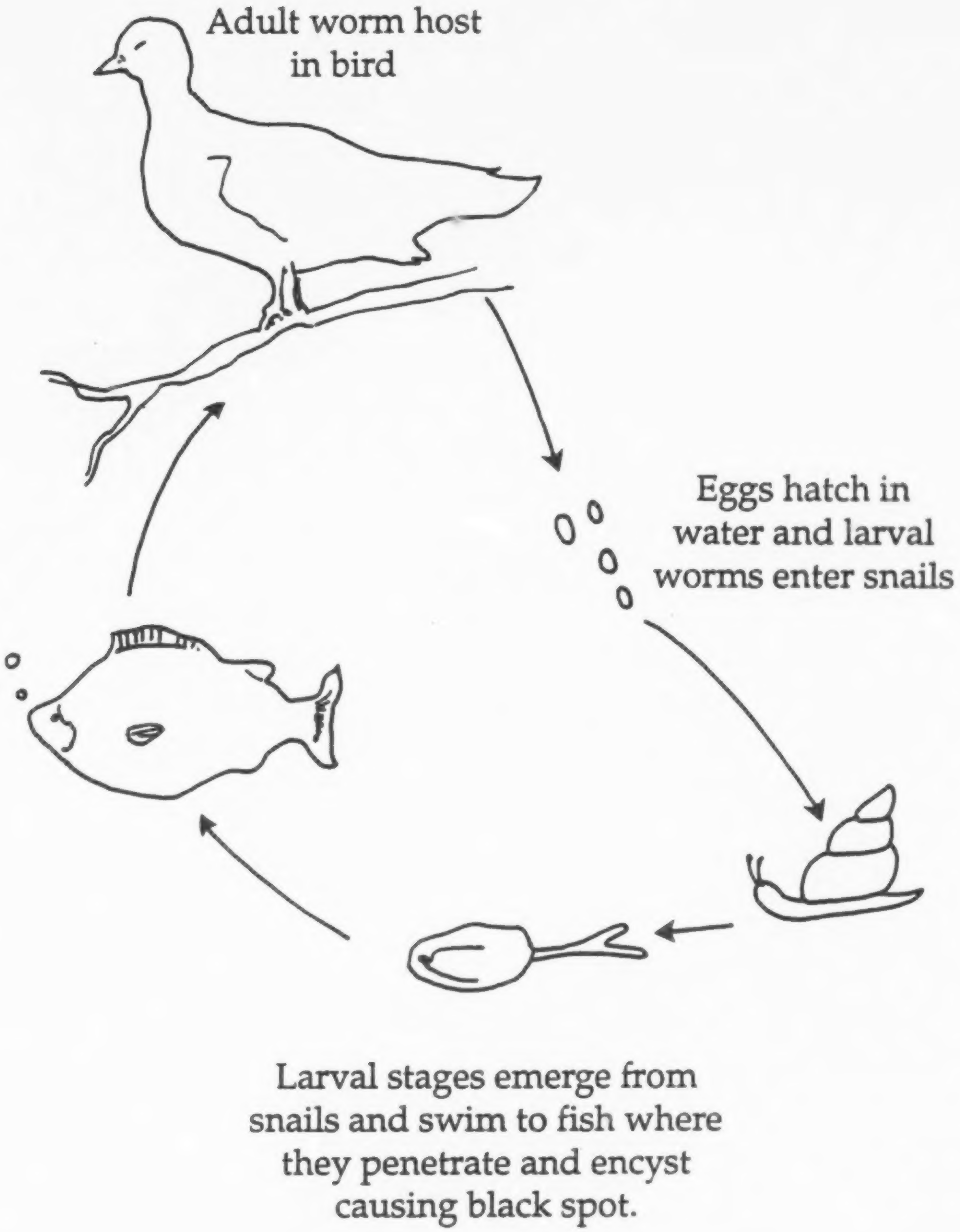
TRANSPARENCY MASTER #1

Ichthyophthiriasis (Ich)


Infected fish
Adult parasite
Encysted stage in bottom of pond
Free-swimming juvenile stage

TRANSPARENCY MASTER #2

Fish Grubs (Larval Flukes)



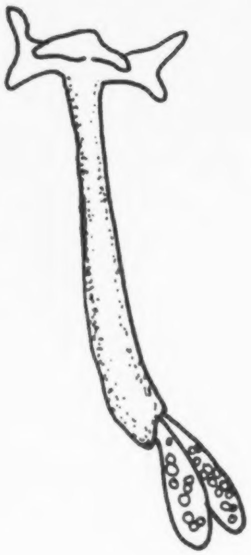
Adult worm host in bird

Eggs hatch in water and larval worms enter snails

Larval stages emerge from snails and swim to fish where they penetrate and encyst causing black spot.

TRANSPARENCY MASTER #3

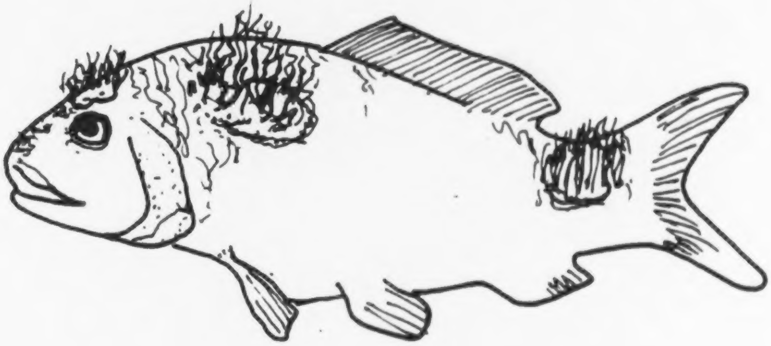
Anchor Parasite



553

TRANSPARENCY MASTER #4

Fungus



TRANSPARENCY MASTER #5

Decision Process for Treating Fish Health Problems

Suspect fish health problems

Obtain diagnosis of problem from fisheries disease specialist or have confidence in personal ability to diagnose problem

Eliminate possible causes of disease or parasite outbreak: overpopulation, handling stress, poor water quality

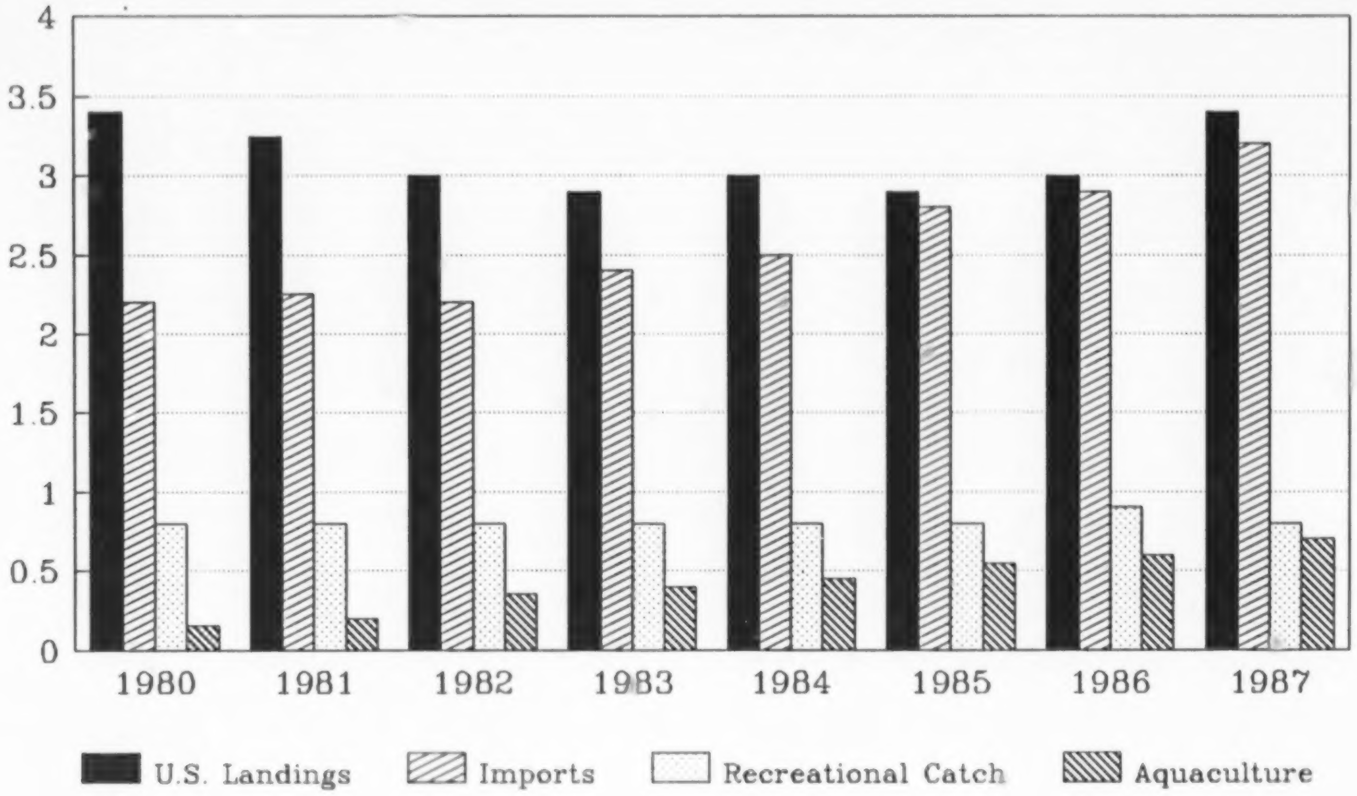
Decide if fish are worth treating based on prognosis, severity of problems, value of fish, and cost of treatment

Treatment not cost effective — eliminate fish and restock

Treatment cost effective — proceed with treatment

U.S. Supply of Edible Fish

Billion Pounds



Courtesy Dan Selock, SIU-C

TRANSPARENCY MASTER #7

Why Fish?

Increased Awareness of the Health Benefits

- Regular fish consumption appears to reduce the potential of developing heart diseases
- Fish adds fewer calories to your diet:

Baked catfish	145 cal./3.5 oz.
Roast chicken breast	170
Broiled beef sirloin	215
Roast pork loin	240

- Fish provides ample vitamins and minerals
- Fish is a good source of protein without high cholesterol

Courtesy Dan Selock, SIU-C

TRANSPARENCY MASTER #8

Aquaculture Markets

Regional and/or Local

- Food Fish (for human consumption)
    - whole dressed
    - fillets
    - steaks
    - smoked
    - air dried
    - caviar

- Bait Minnows
    - golden shiner
    - fathead
    - rosie red

- Aquaria Trade
    - ornamental
    - feeder goldfish

- Paylakes
    - mature fish

- Pond and Lake Stocking
    - immature fish

- Biological Supply Houses

Most need development in Illinois

Courtesy Dan Selock, SIU-C

TRANSPARENCY MASTER #9

Marketing Strategy

Fish farmers wear all the hats

- An Illinois fish farmer must plan, produce, process, price, and promote
- There are no fish cooperatives yet
- What market niche is in your area?
- Price for different situations
- Price, quality, and service — you can only do two of the three at a time
- State-approved processing codes

Courtesy Dan Selock, SIU-C

TRANSPARENCY MASTER DISCUSSION GUIDE

Transparency Masters #1 - 4

1. Use these transparencies as examples of some diseases and parasites encountered by fish.
2. Ich is a common disease in aquariums. Ask students to cite personal examples.
3. Use the descriptions provided with each transparency to lead discussions concerning causative organisms, hosts, life cycles, etc.

Transparency Master #1

The life cycle of the ICH parasite involves several stages. Because treatments for one stage often do not affect the other stages, the disease frequently recurs. The adult stage of this protozoan emerges from the skin and mucus of the infected fish and drops to the bottom of the pond, where it forms a cyst. The organism then undergoes multiple divisions and produces many tiny juvenile forms. Under suitable conditions, these juveniles (theronts) emerge and swim about, seeking a fish (of any species) to penetrate; if they find one, they burrow into it and develop to maturity. Only the free-swimming stages of this parasite are vulnerable to treatment.

Causative organism — *Ichthyophthirius multifiliis*, a ciliated protozoan commonly called Ich.

Susceptible species — All freshwater fishes.

Signs — Small raised spots that resemble sprinkled table salt, over the entire body surface and fins. Affected fish may flash against the bottom of sides of the tank. Heavily infected fish often congregate at the intake or outlet of the pond or tank.

Contributing factors — Poor water quality and malnutrition. Susceptibility is increased when the water source is contaminated with wild fish, and when the water temperature is 60 to 75 degrees F.

Verification — Microscopic examination.

Prevention — Avoid contaminated water supply, etc, and other equipment. Provide water of good quality, and offer nutritionally adequate feeds.

Possible therapeutic agents — Formalin, table salt, copper sulfate, and potassium permanganate.

Transparency Master #2

The spots typical of black-spot disease result from a reaction of the fish's body to the presence of larval parasitic worms in its flesh. The worms reach the adult stage only when an infected fish is eaten by a susceptible bird host. As shown in the figure, the life cycles have at least two free-swimming stages and involve three kinds of hosts: fish, snails, and birds. When an animal other than a bird eats an infected fish, there is no danger of further infection.

Causative organisms — Grubs of the genera *Crassiphiala* and *Uvulifer* (black spot), *Clinostomum* (yellow grub), and *Posthodiplostomum* (white grub).

Susceptible species — Bluegills and other sunfishes, black basses, and most minnows.

Signs — Small pigmented nodules (either black, cream-colored, or white) in the flesh and visceral cavity, and sometimes in the gills.

Contributing factors — Infected fish and the presence of intermediate hosts (fish-eating birds and snails).

Verification — Microscopic examination.

Prevention — Eradicate snails in ponds and remove bird roosts in the vicinity.

Possible therapeutic agents — None.

Transparency Master #3

Causative organism — Parasitic copepod *Lernaea cyprinacea (L. elegans).*

Susceptible species — All freshwater fishes and tadpoles.

Signs — Small reddish lesions on the external surface, often surrounded by fungus. The parasite resembles a shaft of a small barb (similar to a broom straw) inserted into the flesh of the fish. The anchor tends to prevent detachment of the parasite.

Contributing factors — Stocking of fish contaminated with the anchor parasite into parasite-free populations. Movements of wildlife (such as ducks or muskrats) from pond to pond can spread the parasite.

Verification — Visual examination.

Prevention — Avoid stocking parasite-infested stocks of fish.

Possible therapeutic agents — Masoten (Dylox).

Transparency Master #4

Causative organism — Fungi, usually of the genera *Saprolegnia* and *Achlya*.

Susceptible species — All freshwater fishes.

Signs — General "cotton-like" or "fur-like" appearance, usually associated with localized discolored areas or lesions. Fungus assumes the color of materials suspended in the water.

Contributing factors — Generally secondary infections indicative of adverse conditions. Fungus infections seldom become established on healthy fish unless they have been subjected to stress or injury. Stress conditions for "winter kill" include prolonged periods of very low temperatures, malnutrition, and possibly low dissolved oxygen.

Verification — Microscopic examination.

Prevention — Maintain good water quality and feed nutritionally adequate feeds throughout the year (feeding just before winter and in early spring is especially important).

Possible therapeutic agents — Copper sulfate and potassium permanganate.

Transparency Master #5

Lead students in a discussion on why each of the steps is important and the economics behind the decisions to treat or not to treat.

Transparency Master #6

Use this transparency to lead students in a discussion of why aquaculture is a growing enterprise. Point out that the amount of fish taken in landings is rather inelastic and that domestic production can be used to offset the large imports.

Transparency Masters #7 - 9

Use these transparencies to lead a discussion on the necessity of locating a market and strategies that can be used to find a market for potential production.

STUDENT ACTIVITIES

The publication "Raising Catfish in Floating Cages" (Y928) has been provided as a student resource for use as the instructor deems best. The text is applicable both as a study guide or as a practical guide to raising catfish and the considerations that are incumbent on the grower.

For additional activities, teachers may refer to the "Suggested Teaching Activities and Procedures" section in the Instructor's Guide.

Note:

The 4-H Youth Programs Office, Cooperative Extension Service at the University of Missouri graciously granted permission to the Illinois Agricultural Core Curriculum Revision Project to reproduce their publication "Raising Catfish in Floating Cages" (Y928) for distribution to the agricultural educators in Illinois.

This publication may be obtained by contacting:

4-H Youth Programs
210 Whitten
Columbia, MO 65211
(314) 882-3226

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Classifying Game Birds and Animals

RELATED PROBLEM AREAS:

1. Understanding the Relationship Between Agriculture and the Environment (Central Core Cluster)
2. Understanding Basic Genetics and Reproduction (Central Core Cluster)
3. Understanding Animal Anatomy and Physiology (Agricultural Business and Management Cluster)
4. Conserving Wildlife Resources (Central Core Cluster)
5. Feeding Game Birds and Animals
6. Controlling Wildlife Pests
7. Raising Game Birds and Animals
8. Maintaining Wildlife Habitat
9. Managing Game Preserves

PREREQUISITE PROBLEM AREA(S):

1. Identifying Basic Principles of Animal Science (Central Core Cluster)

LEVEL: Preparatory

OCCUPATIONAL TASKS ADDRESSED:

Agricultural Resources Cluster

Duty B: Applying Laws, Regulations, and Policies

1. Interpret game and wildlife laws
2. Maintain permits, certificates, and licenses

Duty D: Managing Facility Flora and Fauna

1. Identify wildlife species within a selected area
2. Identify endangered or exotic species of plant and animal life in a selected area

Agricultural Business and Management Cluster

Duty D: Marketing Animals and Animal Products

1. Sort and mark animals for market

Duty H: Managing the Business

1. Maintain animal records

Duty N: Breeding, Handling, and Caring for Animals

1. Mark or tag animals for identification

STATE GOALS FOR LEARNING

In planning the instruction for this problem area, teachers can promote the development of several student learning objectives which are related to the State Goals for Learning in Biological and Physical Sciences and Social Sciences. These objectives are listed on the Learning Assessment Plan forms included on the following page(s). Those learning objectives marked with an asterisk (*) are taken from the sample lists provided by the Illinois State Board of Education.

Illinois Agricultural Core Curriculum
Agricultural Education 124 Mumford Hall 1301 W. Gregory Drive University of Illinois Urbana, IL 61801

Director: Dale A. Law, Ed.D.
Principal Investigator: Jerry D. Pepple, Ed.D.
Research Assistant: Robert E. Petrea

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

Submission Date ____________
☐ **Original submission** ☐ **Revision**
Page ____ of ____

I. LEARNING AREA *(check one)*
☐ Language Arts
☐ Mathematics
☒ Sciences
☐ Fine Arts
☐ Social Sciences
☐ Physical Development/Health

(Affix label or complete district information.)
COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐
District Name
City

II. STATE GOAL FOR LEARNING
As a result of their schooling, students will have a working knowledge of the concepts and basic vocabulary of biological, physical, and environmental sciences and their application to life and work in contemporary technological society.

Contact Person: ____________
Title: ____________
Phone: ( )

III. LEARNING OBJECTIVES	IV. ASSESSMENT A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	V. EXPECTATIONS Percent of Students Expected to Achieve Objective
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:					
*1. Understand the interactions among populations of plants, herbivores, and carnivores.					
*2. Recognize that the populations of plants and animals change as the environment changes.					
*3. Compare living organisms by a classification scheme.					
4. Define terms integral to classifying game birds and animals					
5. Identify the zoological classification of various game birds and animals					

566

567

ISBE 41-78 (1/88)

Submission Date ____________________
☐ **Original submission** ☐ **Revision**
Page _____ of _____

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

(Affix label or complete district information.)

COUNTY	DISTRICT	ESC

District Name

City

I. LEARNING AREA *(check one)*
☐ Language Arts
☐ Mathematics
☒ Sciences
☐ Fine Arts
☐ Social Sciences
☐ Physical Development/Health

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will have a working knowledge of the social implications of technological development

Contact Person: ____________________
Title: ____________________
Phone: (   )

III. LEARNING OBJECTIVES	IV. ASSESSMENT A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	V. EXPECTATIONS Percent of Students Expected to Achieve Objective
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:					
*1. Identify materials now in use that are replacing natural resources					
*2. Predict the consequences of technological change.					
3. Describe typical characteristics of various species of game birds and animals					

Illinois Agricultural Core Curriculum Rev.

Classifying Game Birds and Animals

Agricultural Resources
Fish and Wildlife Management

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

Submission Date ____________
☐ Original submission ☐ Revision
Page ____ of ____

I. LEARNING AREA *(check one)*

☐ Language Arts
☐ Mathematics
☐ Sciences
☐ Fine Arts
☒ Social Sciences
☐ Physical Development/Health

(Affix label or complete district information.)

COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐

District Name

City

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will be able to apply the skills and knowledge gained in the social sciences to decision making in life situations

Contact Person: ____________
Title: ____________
Phone: ( )

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Understand the knowledge and skills required for success in selected fields of work.					
2. Discriminate between game and non-game animals and summarize the contributions of each to the wildlife community					

Classifying Game Birds and Animals

Agricultural Resources
Fish and Wildlife Management

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Classifying Game Birds and Animals

STUDENT LEARNING OBJECTIVES

Upon completion of their study of this problem area, students will be able to:

1. Define terms integral to classifying game birds and animals.
2. Identify the zoological classification of various game birds and animals.
3. Describe common methods of classifying game birds and animals.
4. Describe typical characteristics of various species of game birds and animals.
5. Discriminate between game and non-game animals and summarize the contributions of each to the wildlife community.

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Classifying Game Birds and Animals

PROBLEMS AND QUESTIONS FOR STUDY

1. What are the zoological classifications of game birds?
2. What are the zoological classifications of game animals?
3. Where can one find the zoological classifications of game birds and animals?
4. What is the difference between a game and a non-game bird? Game and non-game animal?
5. What are waterfowl?
6. What are birds of prey?
7. What are fur bearers?
8. What is the difference between big game and small game?
9. What animals can be classified as forest game?
10. What animals can be classified as migratory game?
11. What roles do game animals play in the wildlife community?
12. What roles do non-game animals play in the wildlife community?
13. What is an endangered species? A threatened species?
14. Are endangered species game or non-game animals?
15. What are the characteristics of reptiles, amphibians, birds, and mammals?
16. How does one distinguish the tracks of a game bird from a non-game bird?
17. How does one distinguish the tracks of a game animal from a non-game animal?

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Classifying Game Birds and Animals

SUGGESTED TEACHING ACTIVITIES AND PROCEDURES

1. Use resource persons from the Illinois Department of Conservation (Division of Wildlife Resources, Endangered Species Program, Division of Forest Resources), Illinois Natural History Survey Wildlife Specialists, U.S. Forest Service, Fish and Wildlife Service (U.S. Department of Interior), local hunting organizations, local trappers, Cooperative Extension personnel, and local chapters of organizations such as Ducks Unlimited for specific species information as required by students.

2. Conduct field trips to local urban parks, forest preserves, game preserves, specialty animal hobbyists, producers of game birds for release, state parks, or individually owned acres for wildlife where both game and non-game animals may be observed and studied.

3. Use the referenced texts and publications as student resources for additional species-specific information.

4. Use the problem areas *Identifying Basic Principles of Animal Science*, *Understanding Animal Anatomy and Physiology*, and *Understanding Animal Breeding and Reproduction* as resources for review of basic principles and concepts. Use these problem areas as a basis for leading students in a discussion of the similarities between domesticated production animals and non-domesticated game and non-game animals.

5. Ask students that regularly hunt or trap to give presentations on specific target species and the techniques used in seeking those species. Prompt students with questions on how those techniques reflect natural characteristics of those species.

6. Lead students in a discussion of the game bird and animal industry on the local economy.

7. Have students identify a single game species and a related non-game species and have the students conduct research relating to classification, habitat, feeding requirements, mating, etc. of the two species. Have the students research how one came to be a game species and the other did not.

8. Coordinate with other life science personnel the use of needed models or equipment for presentations or demonstrations.

9. Invite a local taxidermist to the class to give a demonstration of techniques used with game birds and animals.

10. Obtain copies of "Illinois Wildlife" from the Illinois Department of Conservation. These single page fliers can be used as student reference materials for individual studies or for teacher prepared study guides.

11. Use the various classifications of wildlife as starting points for possible SAE or SOE projects.

12. Use the problem area *Conserving Wildlife Resources* for information concerning the game species of rabbit, squirrel, pheasant, bobwhite quail, white tail deer, and mourning dove. This problem area can be used as a resource for student reference and activities. .

13. Use Information Sheets #3 and #4 as starting points for individual study into a specific species. The zoological classifications can be used to identify the specific characteristics of a particular species and how other species are similar to and different from those species. This activity will reinforce the classification system and its use in Zoology.

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Classifying Game Birds and Animals

SUGGESTED TEACHING ACTIVITIES AND PROCEDURES (con't.)

INSTRUCTOR'S NOTES AND REFERENCES

14. Use Student Worksheet #1 as a class exercise to classify animals by their tracks. This activity can be used as reinforcement for habitats in which particular animals may be found. This activity can be carried further by using track molds and preservation kits available from Nasco or Carolina Biological. Replica molds can be made for student practice and the techniques can be adapted for field sample preservation.

15. Consult the problem area *Classifying Fish* for a more complete description of the various elements taken into consideration by the zoological classification scheme. This area can be used for student research in conjunction with item #13 above. A text such as "Mammals of Illinois" contains the various characteristics of each order of mammals covered.

16. Invite a conservation police officer to address the class on conservation laws in general and game seasons in particular.

17. Use Information Sheet #6 as a key for Student Worksheet #2.

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Classifying Game Birds and Animals

REFERENCES

1. *Practical Wildlife Management.* Burger, G. V. (1973). Winchester Press, 460 Park Avenue, New York, NY 10022.

*2. *Mammals of Illinois.* Hoffmeister, D. F. (1989). University of Illinois Press, c/o Cup Services, P.O. Box 6525, Ithaca, NY 14651. (800) 666-2211.

*3. *Grzimek's Animal Life Encyclopedia.* Grzimek, B., ed. International Specialized Books, 5602 N.E. Hassalo Street, Portland, OR 97213. (800) 547-7734.

4. *Integrated Principles of Zoology.* Hickman, C. P., Jr., Roberts, L. S., Hickman, F. M. (1988). Time Mirror/Mosby College Publishing, 11830 Westline Industrial Drive, St. Louis, MO 63146.

*5. *Waterfowl Identification (8985-E), Agricultural Resources Technical Information (114 B).* Instructional Materials Service, Texas A & M University, Box 2588, College Station, TX 77843-2488.

*6. *Illinois 4-H Wildlife Conservation Manual.* (1980). U.S. Department of Agriculture, Cooperative Extension Service, UIUC.

*7. *The Wild Turkey in Illinois.* Garver, J. K. (1987). Illinois Department of Conservation, Division of Wildlife Resources, Springfield, IL 62706.

*8. *Illinois Wildlife.* (Wildlife pamphlets). Illinois Department of Conservation, Fish and Wildlife Resources, Springfield, IL 62706.

9. Biological Notes:
   Illinois Birds: Mimidae #68. (1970)
   Illinois Birds: Turdidae #75. (1971)
   Illinois Birds: Hirundinidae #80. (1972)
   Illinois Birds: Laniidae #83. (1973)
   Illinois Birds: Tyrannidae #86. (1974)
   Illinois Birds: Picidae #102. (1977)
   Illinois Birds: Conconiiformes #109. (1978)
   Illinois Birds: Sylviidae #110. (1979)
   Illinois Birds: Wood Warblers #118. (1983)
   Illinois Birds: Vireos #124. (1985)
   Illinois Birds: Corvidae #126. (1985)
   Garber, J. W., Garber R. R., Kirk, E. L. Natural History Survey, Natural Resources Building, 607 E. Peabody Drive, Champaign, IL 61820.

10. *Investigations in Conservation of Natural Resources.* (1979). Interstate Publishers, Inc., P.O. Box 50, Danville, IL 61834-0050. (217) 446-0500.

*11. *Checklist of Endangered and Threatened Animals and Plants of Illinois.* (March 1989). Endangered Species Program, Natural Heritage Division, Department of Conservation, Lincoln Tower Plaza, 524 S. Second, Springfield, IL 62701-1787.

*Indicates highly recommended reference

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTIONAL RESOURCES

These resources are intended for use by teachers in planning and teaching the materials for this problem area and may be adapted to fit the teaching method(s) used.

INFORMATION SHEET #1 — Terms to be Defined

INFORMATION SHEET #2 — Common Classifications

INFORMATION SHEET #3 — Zoological Classification of Selected Game Species

INFORMATION SHEET #4 — Zoological Classification of Selected Non-Game Species

INFORMATION SHEET #5 — Endangered and Threatened Wildlife

INFORMATION SHEET #6 — Terms for Creatures

TRANSPARENCY MASTER #1 — Parts of a Bird

TRANSPARENCY MASTER #2 — Waterfowl Game Examples

TRANSPARENCY MASTER #3 — Game Bird Examples

TRANSPARENCY MASTER #4 — Fur-bearing Game Examples

TRANSPARENCY MASTER #5 — Large Game Animals in Illinois

INFORMATION SHEET #1

Terms to be Defined

Wildlife — All non-domesticated animals with backbones such as fish, birds, mammals, amphibians, and reptiles.

Game Animals — Wildlife that may be harvested according to regulated seasons and bag limits.

Small Game — Relatively small huntable mammals and birds commonly associated with wildlands and farmlands.

Large Game — Relatively large huntable mammals; only one species, the deer, in Illinois.

Mammals — Warm blooded, usually hairy vertebrates that feed offspring with milk secreted by mammary glands.

Amphibians — Normally scaleless, cold-blooded animals that pass through a lifecycle, including tadpoles with gills.

Reptiles — Animals that are covered with scales, are cold-blooded, have a three chambered heart, lungs, and an entirely bony skeleton.

Avians — Animals that are two-legged, warm-blooded, lay eggs, and have feathers and wings.

Migratory — Those species with the characteristic of moving from one region to another with the change of seasons, usually considered to be a round trip.

Raptor — A predatory bird characterized by a notched beak and strong, sharp talons such as an owl, hawk, eagle, etc.

Federally Endangered Species — Any species which is in danger of extinction throughout all or a significant portion of its range.

Federally Threatened Species — Any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

State Endangered Species — Any species which is in danger of extinction as a breeding species in Illinois.

State Threatened Species — Any breeding species which is likely to become a state endangered species within the foreseeable future in Illinois.

Take — In reference to animals and animal products, to harm, hunt, shoot, pursue, lure, wound, kill, destroy, harass, gig, spear, ensnare, trap, capture, collect, or to attempt to engage in such conduct; in reference to plants and plant products, to collect, pick, cut, dig up, kill, destroy, bury, crush, or harm in any manner.

INFORMATION SHEET #2

Common Classifications

- Game Species
    - Coyote
    - Striped skunk
    - Woodchuck
    - Crow
    - Squirrel
    - Turkey
    - Deer
    - Cock pheasant
    - Quail
    - Hungarian partridge
    - Rabbit
    - Raccoon
    - Opossum
    - Fox (red or gray)
- Trapping Species
    - Raccoon
    - Opossum
    - Skunk
    - Weasel
    - Mink
    - Muskrat
    - Beaver
    - Fox (red or gray)
    - Coyote
    - Woodchuck
- Migratory Game Birds
    - Dove
    - Rail
    - Snipe
    - Woodcock
- Migratory Game Waterfowl
    - Ducks
    - Coots
    - Geese
- Large Animals
    - Deer
- Medium Animals
    - Turkey
    - Opossum
    - Beaver
    - Coyote
    - Fox
    - Badger
    - Otter
    - Bobcat
    - Great blue heron
    - Great egret
- Small Animals
    - Rabbit
    - Pheasant
    - Quail
    - Partridge
    - Mourning dove
    - Shrew
    - Mice
    - Squirrel
    - Song bird
    - Lesser egret
- Fur Bearers
    - Opossum
    - Beaver
    - Muskrat
    - Coyote
    - Fox
    - Raccoon
    - Weasel
    - Mink
    - Badger
    - Striped skunk
    - River otter
    - Bobcat

INFORMATION SHEET #3

Zoological Classification of Selected Game Species*

Pintail Duck

Phylum	Chordata
Class	Aves
Order	Anseriformes
Family	Anatidae
Genus	Anas
Species	anus acuta

Mallard Duck

Phylum	Chordata
Class	Aves
Order	Anseriformes
Family	Anatidae
Genus	Anas
Species	anus platyhrnchos

Mink

Phylum	Chordata
Class	Mammalia
Order	Artiodactyla
Family	Mustelidae
Genus	Mustela
Species	vison

Opossum

Phylum	Chordata
Class	Mammalia
Order	Marsupialia
Family	Didezphidae
Genus	Didelphis
Species	virginiana

Beaver

Phylum	Chordata
Class	Mammalia
Order	Rodentia
Family	Castocidae
Genus	Castor
Species	anadensis

White-tailed Deer

Phylum	Chordata
Class	Mammalia
Order	Artiodactyla
Family	Cervidae
Genus	Odocoileus
Species	virginianus

Coyote

Phylum	Chordata
Class	Mammalia
Order	Carnivora
Family	Canidae
Genus	Canis
Species	atrans

Raccoon

Phylum	Chordata
Class	Mammalia
Order	Carnivora
Family	Procyonidae
Genus	Procyon
Species	lotor

Eastern Cottontail

Phylum	Chordata
Class	Mammalia
Order	Lagomorpha
Family	Leporidae
Genus	Sylvilagus
Species	floridanus

Wild Turkey

Phylum	Chordata
Class	Aves
Order	Galliformes
Family	Phasianidae
Genus	Meleagris
Species	meleagris gallopavo

Crow

Phylum	Chordata
Class	Aves
Order	Passeriformes
Family	Corvidae
Genus	Corvus
Species	brachyrhynchos

Gray Squirrel

Phylum	Chordata
Class	Mammalia
Order	Rodentia
Family	Sciuridae
Genus	Sciurus
Species	carolinensis

Mourning Dove

Phylum	Chordata
Class	Aves
Order	Columbiformes
Family	Columbidae
Genus	Zenaidura
Species	macroura

Bull Frog

Phylum	Chordata
Class	Amphibia
Order	Anura
Family	Ranidae
Genus	Rana
Species	rana catesbetana

***After Grzimek and Hoffmeister**

INFORMATION SHEET #4

Zoological Classification of Selected Non-Game Species*

Pileated Woodpecker

Phylum	Chordata
Class	Aves
Order	Piciformes
Family	Picidae
Genus	Dryocopus
Species	dryocopus pileatus

Barred Owl

Phylum	Chordata
Class	Aves
Order	Strigiformes
Family	Strigidae
Genus	Strix
Species	strix varia

Cattle Egret

Phylum	Chordata
Class	Aves
Order	Ciconiiformes
Family	Ardeidae
Genus	Bubulcus
Species	ibis

Blue Jay

Phylum	Chordata
Class	Aves
Order	Passeriformes
Family	Corvidae
Genus	Cyanocitta
Species	cristata

Robin

Phylum	Chordata
Class	Aves
Order	Passeriformes
Family	Turdidae
Genus	Turdus
Species	migratorius

Big Brown Bat

Phylum	Chordata
Class	Mammalia
Order	Chiroptera
Family	Vespertilionidae
Genus	Eptesicus
Species	fuscus

Bobcat

Phylum	Chordata
Class	Mammalia
Order	Carnivora
Family	Fezidae
Genus	Fezis
Species	rufus

Prairie Vole

Phylum	Chordata
Class	Mammalia
Order	Rodentia
Family	Muridae
Subfamily	Microtinae
Genus	Microtus
Species	ochrogaster

Eastern Chipmunk

Phylum	Chordata
Class	Mammalia
Order	Rodentia
Family	Sciuridae
Genus	Tamias
Species	striatus

Cardinal

Phylum	Chordata
Class	Aves
Order	Passeriformes
Family	Oscines
Genus	Emberizidae
Species	cardinalis

***After Grzimek and Hoffmeister**

INFORMATION SHEET #5

Endangered and Threatened Wildlife

REPTILES AND AMPHIBIANS

Endangered

Silvery Salamander	*Ambystoma platineum*
Dusky Salamander	*Desmognathus fuscus*
Illinois Mud Turtle	*Kinosternon flavescens*
Spotted Turtle	*Clemmys guttata*
Slider	*Pseudemys concinna*
Broad-banded Watersnake	*Nerodia fasciata*
Eastern Ribbon Snake	*Thamnophis sauritus*

Threatened

Illinois Chorus Frog	*Pseudacris streckeri*
Western Hognose Snake	*Heterodon nasicus*
Coachwhip Snake	*Masticophis flagellum*
Great Plains Rat Snake	*Elaphe guattata*
Green Watersnake	*Nerodia cyclopion*

BIRDS

Endangered

Pied-billed Grebe	*Podilymbus podiceps*
Double-crested Cormorant	*Phalacrocorax auritus*
American Bittern	*Botaurus lentiginosus*
Least Bittern	*Ixobrychus exilis*
Great Egret	*Casmerodius albus*
Snowy Egret	*Egretta thula*
Little Blue Heron	*Egretta caerulea*
Black-crowned Night Heron	*Nycticorax nycticorax*
Osprey	*Pandion haliaetus*
Mississippi Kite	*Ictinia mississippiensis*
Bald Eagle	*Haliaeetus leucocephalus*
Northern Harrier (Marsh Hawk)	*Circus cyaneus*
Sharp-shinned Hawk	*Accipiter striatus*
Cooper's Hawk	*Accipiter cooperii*
Red-shouldered Hawk	*Buteo lineatus*
Swainson's Hawk	*Buteo swainsoni*
Peregrine Falcon	*Falco peregrinus*
Greater Prairie Chicken	*Tympanuchus cupido*
Yellow Rail	*Coturnicops noveboracensis*
Black Rail	*Laterallus jamaicensis*
Purple Gallinule	*Porphyrula martinica*
Sandhill Crane	*Grus canadensis*
Piping Plover	*Charadrius melodus*
Upland Sandpiper	*Bartramia longicauda*
Wilson's Phalarope	*Phalaropus tricolor*
Common Tern	*Stern hirundo*
Forster's Tern	*Sterna forsteri*
Least Tern	*Sterna antillarum*
Black Tern	*Chlidonias niger*
Barn Owl	*Tyto alba*
Long-eared Owl	*Asia otus*
Short-eared Owl	*Asio flammeus*
Bewick's Wren	*Thryomanes bewickii*
Swainson's Warbler	*Limnothlypis swainsonii*
Bachman's Sparrow	*Aimophila aestivalis*
Clay-colored Sparrow	*Spizella pallida*
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*

Threatened

Common Moorhen	*Gallinula chloropus*
Brown Creeper	*Certhia americana*
Veery	*Catharus fuscescens*
Loggerhead Shrike	*Lanius ludovicianus*
Henslow's Sparrow	*Ammodramus henslowii*
Brewer's Blackbird	*Euphagus cyanocephalus*

MAMMALS

Endangered

Southeastern Myotis	*Myotis austroriparius*
Gray Bat	*Myotis grisescens*
Indiana Bat	*Myotis sodalis*
Rafinesque's Big-eared Bat	*Plecotus rafinesquii*
River Otter	*Lutra canadensis*
Eastern Wood Rat	*Neotoma floridana*
White-tailed Jackrabbit	*Lepus townsendii*

Threatened

Bobcat	*Lynx rufus*
Golden Mouse	*Ochrotomys nuttalli*
Rice Rat	*Oryzomys palustris*

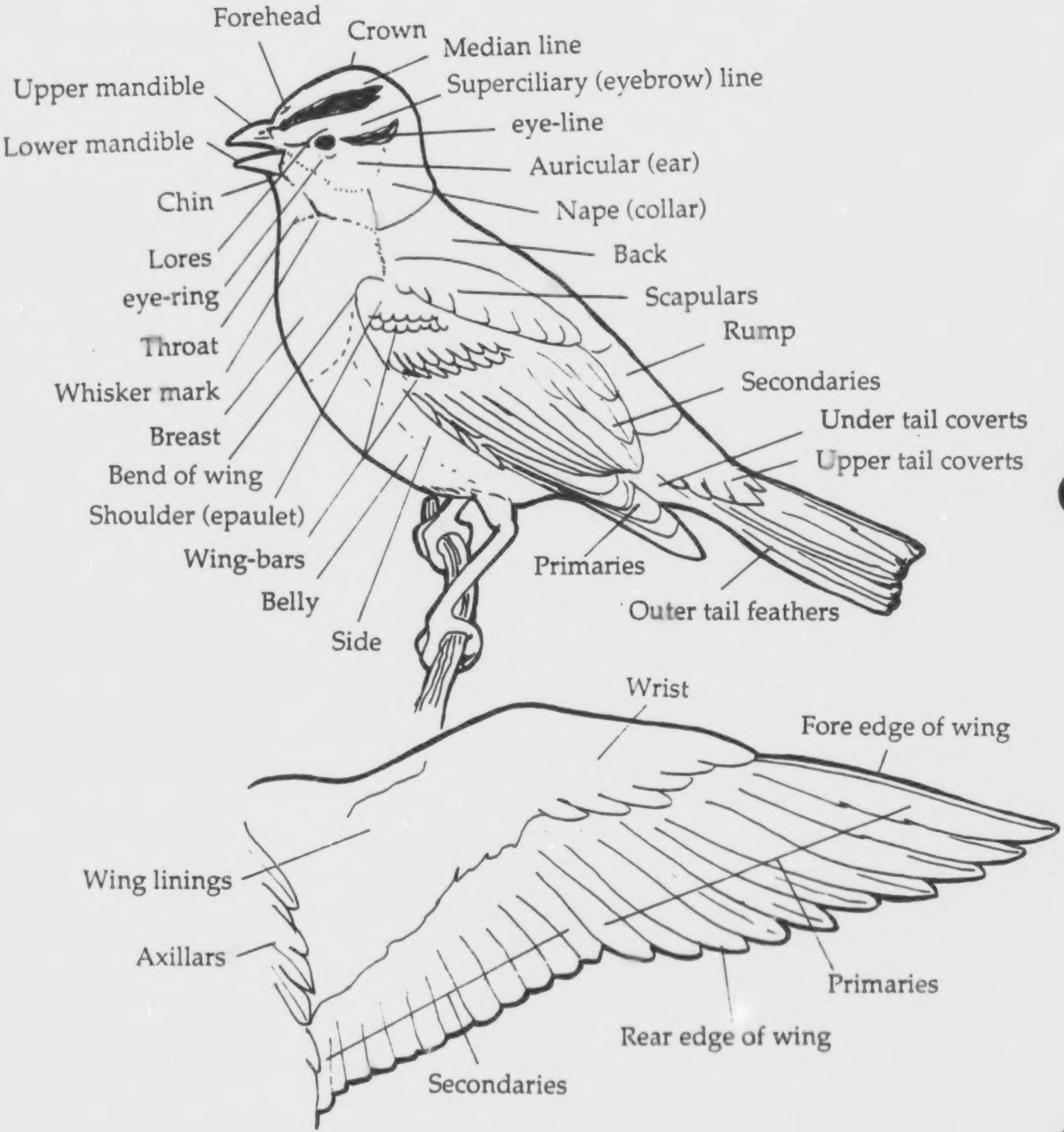
INFORMATION SHEET #6

Terms for Creatures

Creature	Group	Male	Female	Young
Antelope	herd	buck	doe	kid
Badger	cete	boar	sow	
Bear	sloth			cub
Beaver				kitten
Bee	swarm, hive	drone	queen	
Camel	herd, flock	bull	cow	foal, calf, colt
Cod			codling, sprag	
Crane	herd			
Crow	murder			
Deer	herd	buck, stag	doe	fawn
Duck	team (in flight) paddling (in water)	drake	duck	duckling
Eagle	convocation			eaglet
Elephant	herd	bull	cow	calf
Elk	gang	bull	cow	calf
Fish (general)	shoal, school, run			fry
Frog	army			
Fox	earth, skulk	vix	vixen	cub
Goose	flock, skein (in flight), gaggle (on water)	gander	goose	gosling
Grouse	covey (family) pack (larger group)			
Hare	drove, trace	buck	doe	leveret
Hawk	flight			eyas
Kangaroo	troop			joey
Leopard	leap	leopard	leopardess	
Lion	pride, flock, troop	lion	lioness	cub
Lobster			hen	chicken, lobster
Mackerel	shoal			spike, blinker, tinker
Mouse	nest			
Owl				owlet
Partridge	covey			squeaker
Pheasant	nye (young), brood			
Pigeon	flight, flock			squab, squealer, squeaker
Quail	bevy			
Seal	crash, herd, pod			cub
Squirrel	dray			
Swan	herd, wedge	cob	pen	cygnet
Toad	knot			
Turkey	flock	tom	hen	poult
Whale	herd, school, gam, pod	bull	cow	calf
Wolf	herd, rout, pack	dog wolf	bitch	whelp, cub

TRANSPARENCY MASTER #1

Parts of a Bird

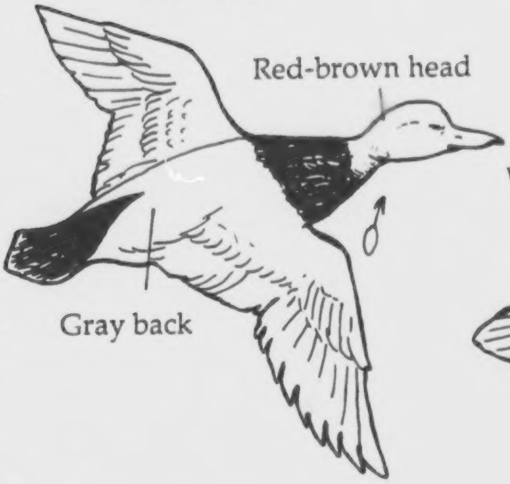

Forehead
Crown
Median line
Upper mandible
Superciliary (eyebrow) line
eye-line
Lower mandible
Auricular (ear)
Chin
Nape (collar)
Back
Lores
eye-ring
Scapulars
Throat
Rump
Whisker mark
Secondaries
Under tail coverts
Breast
Upper tail coverts
Bend of wing
Shoulder (epaulet)
Wing-bars
Primaries
Belly
Outer tail feathers
Side
Wrist
Fore edge of wing
Wing linings
Axillars
Primaries
Rear edge of wing
Secondaries

TRANSPARENCY MASTER #2

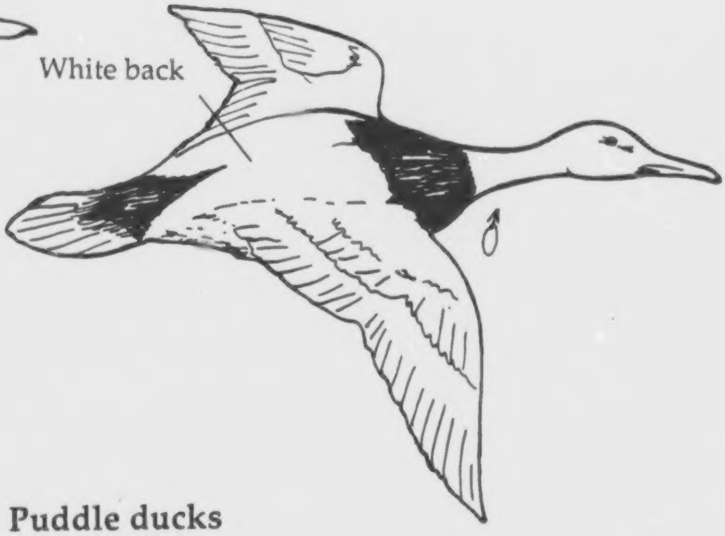
Waterfowl Game Examples

Diving ducks

Redhead

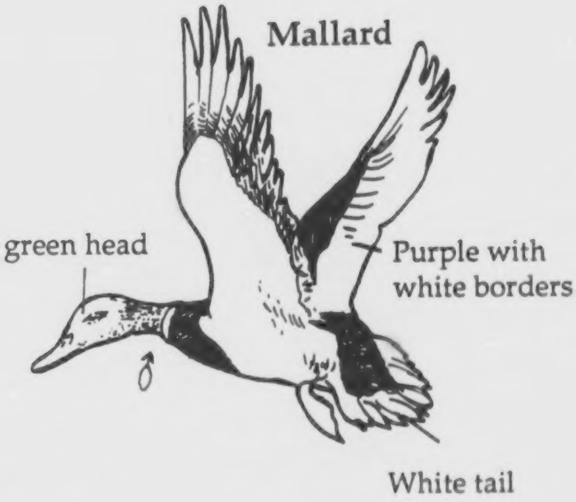

Red-brown head
♂
Gray back

Canvas back

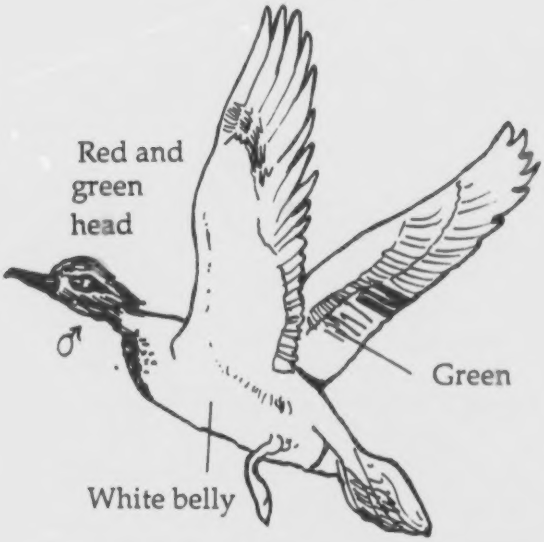


Puddle ducks

Mallard

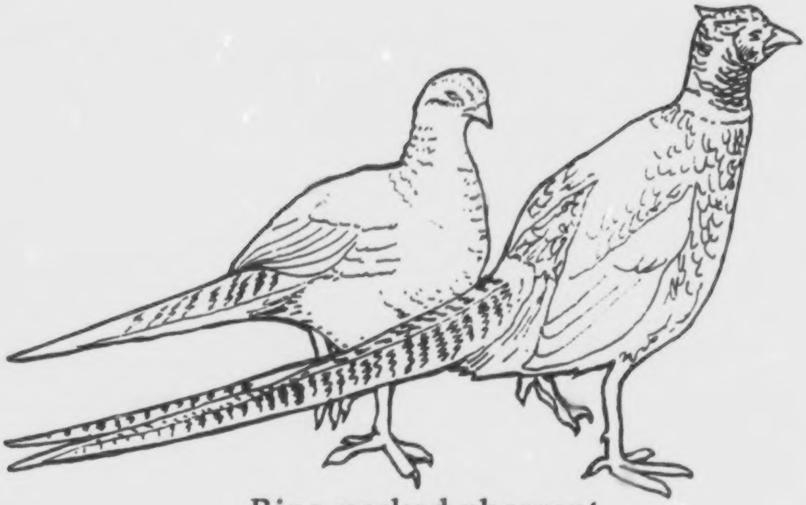

green head
♂
Purple with white borders
White tail

Green winged teal

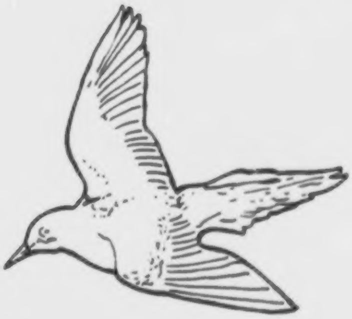

Red and green head
♂
Green
White belly

TRANSPARENCY MASTER #3

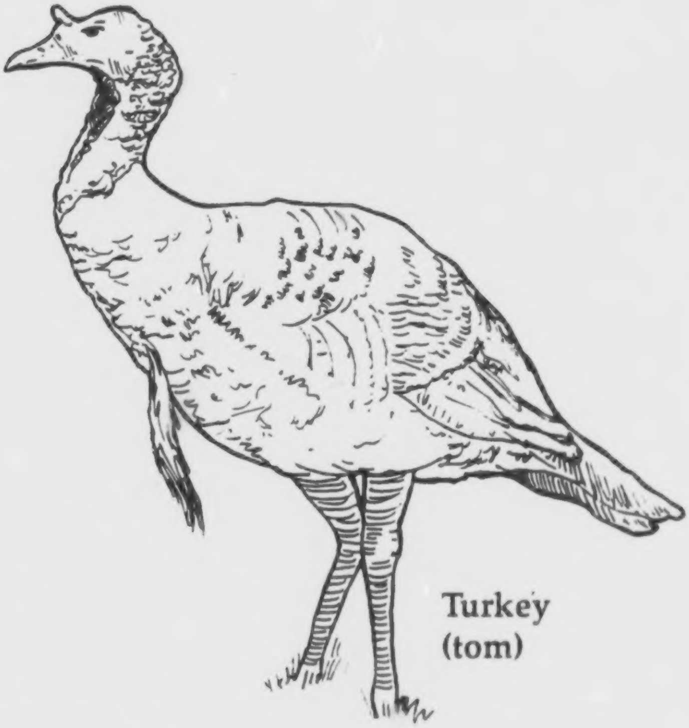
Game Bird Examples



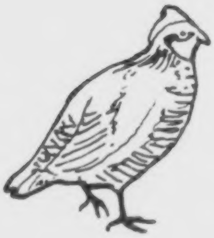
Ring-necked pheasant



Mourning dove



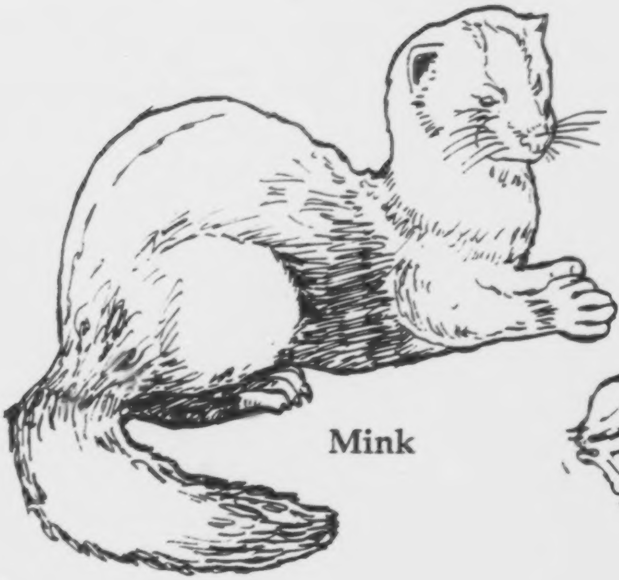
Turkey
(tom)



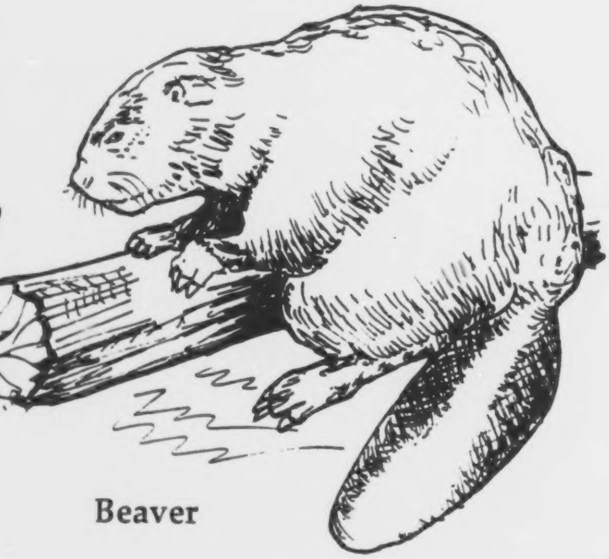
Bobwhite

TRANSPARENCY MASTER #4

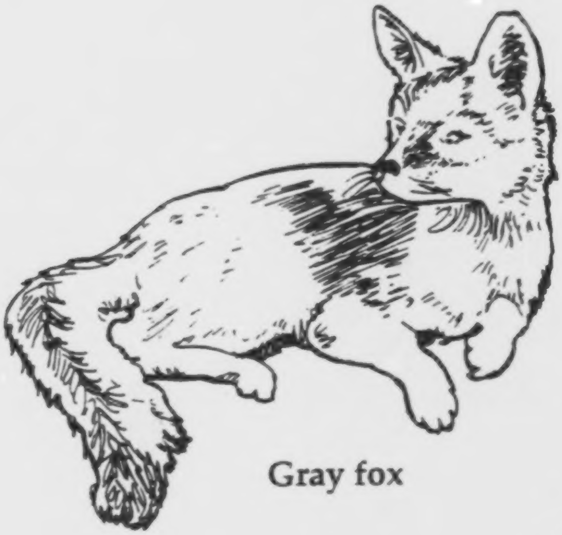
Fur-bearing Game Examples



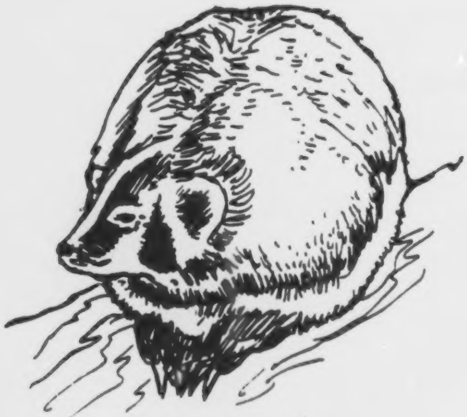
Mink



Beaver



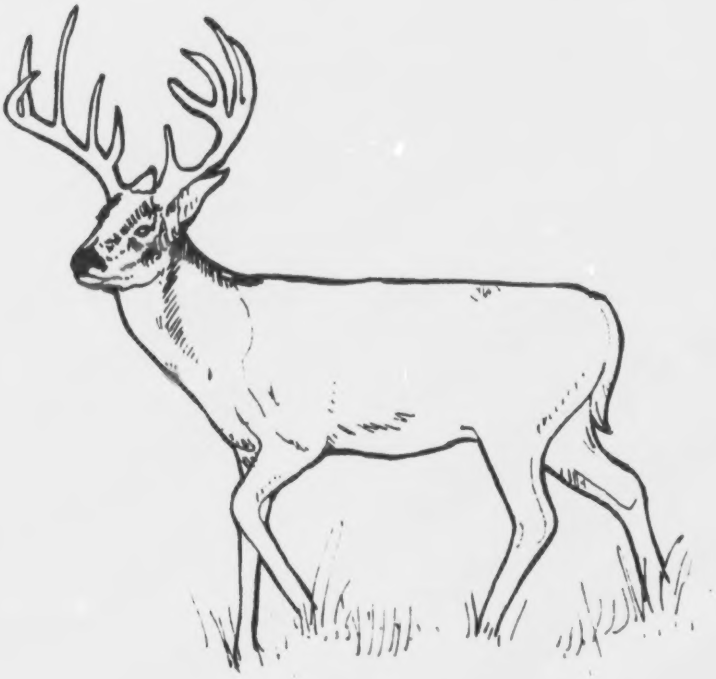
Gray fox



Badger

TRANSPARENCY MASTER #5

Large Game Animals in Illinois



White-tailed deer

STUDENT ACTIVITIES

STUDENT WORKSHEET #1 — Track Identification

STUDENT WORKSHEET #2 — Species Names

For additional activities, teachers may refer to the "Suggested Teaching Activities and Procedures" section in the Instructor's Guide.

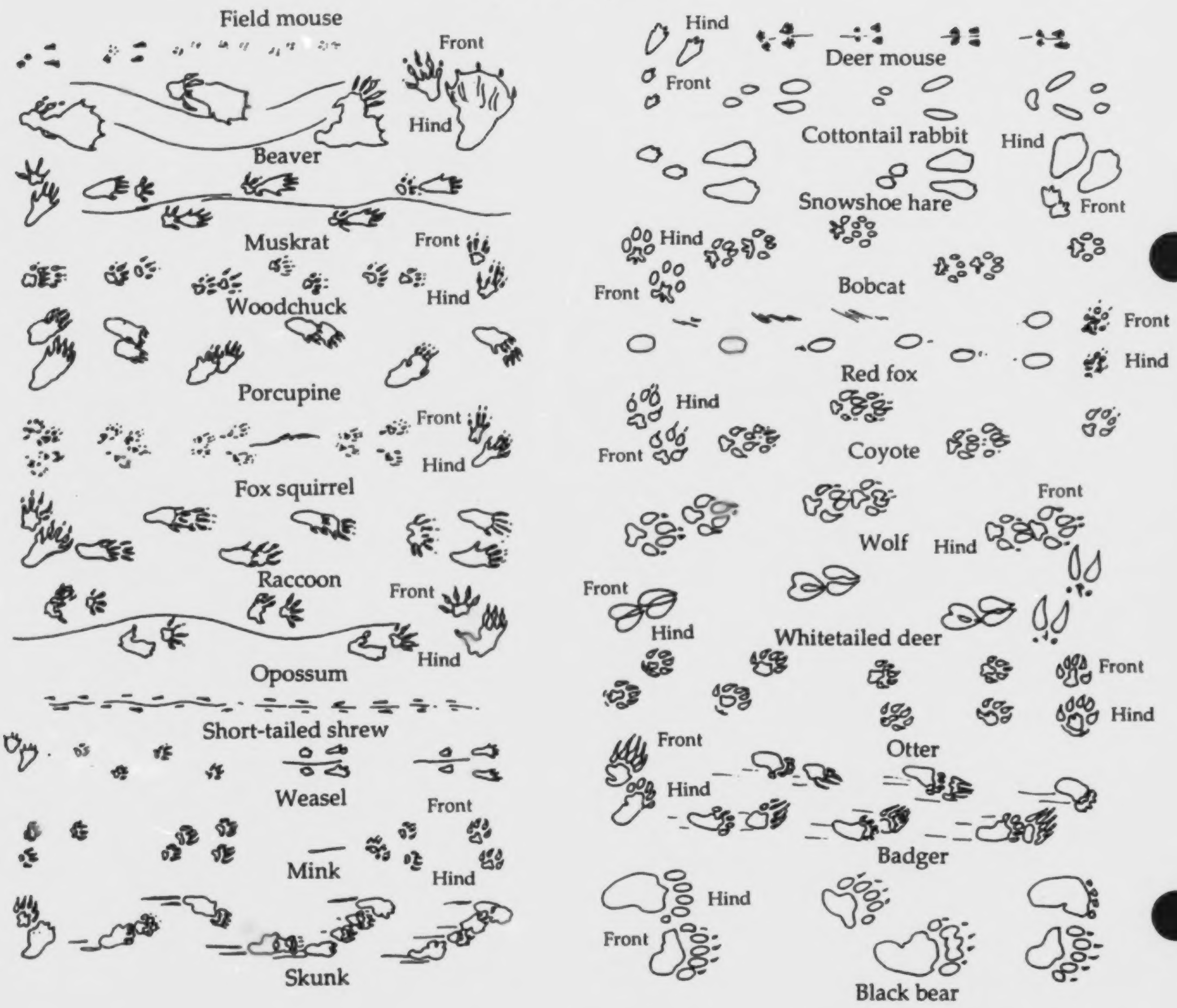
STUDENT WORKSHEET #1

Track Identification

This exercise is designed to focus the student on a specific species with the original evidence being the tracks. Nearly any wooded location or low area will contain tracks. Pick an area where fresh tracks may be found and assign students to draw replicas of the tracks, identify the animal, and answer pertinent questions about the animal.

Name of Animal:
Zoological Classification:
Common Classification:
Close Relatives:
Habitat Characteristics:
Required Food:
Is the Animal a Game or Non-Game Species:
If a Game Species, Identify Hunting or Trapping Regulations:

Sample Animal Tracks


Field mouse
Front
Hind
Beaver
Muskrat
Front
Hind
Woodchuck
Porcupine
Front
Hind
Fox squirrel
Raccoon
Front
Hind
Opossum
Short-tailed shrew
Weasel
Front
Mink
Hind
Skunk
Hind
Deer mouse
Front
Cottontail rabbit
Hind
Snowshoe hare
Front
Hind
Front
Bobcat
Front
Hind
Red fox
Hind
Front
Coyote
Front
Wolf
Hind
Front
Hind
Whitetailed deer
Front
Hind
Front
Otter
Hind
Badger
Hind
Front
Black bear

STUDENT WORKSHEET #2

Species Names

Use the following table to write the names for the categories for each species. Your instructor will provide you with a list of species to use as a starting point.

Species	Group	Male	Female	Young

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Feeding Game Birds and Animals

RELATED PROBLEM AREAS:

1. Understanding the Relationship Between Agriculture and the Environment (Central Core Cluster)
2. Identifying Basic Principles of Animal Science (Central Core Cluster)
3. Classifying Game Birds and Animals
4. Controlling Wildlife Pests
5. Raising Game Birds and Animals
6. Managing Game Preserves
7. Managing Hunting and Fishing Clubs
8. Maintaining Wildlife Habitat
9. Understanding Animal Anatomy and Physiology (Agricultural Business and Management Cluster)

PREREQUISITE PROBLEM AREA(S):

1. Meeting Nutritional Needs of Animals (Agricultural Business and Management Cluster)

LEVEL: Preparatory

OCCUPATIONAL TASKS ADDRESSED:

Agricultural Resources Cluster

Duty A: Managing the Recreational Facility

1. Requisition materials, supplies, and services
2. Maintain inventory records
3. Complete business forms

Duty B: Applying Laws, Regulations, and Policies

1. Maintain permits, certificates, and licenses

Duty D: Managing Facility Flora and Fauna

1. Identify plant communities and dominant species within a selected area
2. Identify wildlife species within a selected area

Duty F: Using Tools, Materials, and Equipment

1. Transport supplies using motorized, wheeled, or tracked equipment
2. Use hand tools
3. Perform preventative maintenance on equipment
4. Perform preventative maintenance on tools

Duty G: Assembling, Servicing, and Maintaining Equipment and Facilities

1. Follow a facility and grounds maintenance schedule

STATE GOALS FOR LEARNING

In planning the instruction for this problem area, teachers can promote the development of several student learning objectives which are related to the State Goals for Learning in Biological and Physical Sciences. These objectives are listed on the Learning Assessment Plan forms included on the following page(s). Those learning objectives marked with an asterisk (*) are taken from the sample lists provided by the Illinois State Board of Education.

Illinois Agricultural Core Curriculum
Agricultural Education 124 Mumford Hall 1301 W. Gregory Drive University of Illinois Urbana, IL 61801

Director: Dale A. Law, Ed.D.
Principal Investigator: Jerry D. Pepple, Ed.D
Research Assistant: Robert E. Petrea

Submission Date ______________
☐ Original submission ☐ Revision
Page ____ of ____

I. LEARNING AREA *(check one)*
☐ Language Arts ☐ Fine Arts
☐ Mathematics ☐ Social Sciences
☒ Sciences ☐ Physical Development/Health

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

(Affix label or complete district information.)
COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐
District Name
City

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will have a working knowledge of the social and environmental implications and limitations of technological development.

Contact Person: ______________
Title: ______________
Phone: ( )

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Identify materials now in use that are replacing natural resources.					
*2. Use the scientific method to formulate an opinion on an environmental issue.					
3. Identify common foodstuffs eaten by specific species of wildlife.					
4. Describe the relationship between foodstuffs and habitat for specific species of wildlife.					
5. Adopt a personal philosophy concerning the advisability of providing food by means of feeding stations.					
594					595

ISBE 41-78 (1/88)

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

Submission Date ____________
☐ **Original submission** ☐ **Revision**
Page ____ of ____

I. LEARNING AREA *(check one)*
☐ Language Arts
☐ Mathematics
☒ Sciences
☐ Fine Arts
☐ Social Sciences
☐ Physical Development/Health

(Affix label or complete district information.)

COUNTY	DISTRICT	ESC

District Name
City

II. STATE GOAL FOR LEARNING
As a result of their schooling, students will have a working knowledge of the concepts and basic vocabulary of biological, physical, and environmental sciences and their application to life and work in contemporary technological society.

Contact Person: ____________
Title: ____________
Phone: ( )

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Relate the processes by which organisms capture, utilize, and release energy.					
*2. Understand the interactions among populations of plants, herbivores, and carnivores.					
*3. Recognize that good conservation practices depend on understanding the balance between living things and their environment.					
4. Define terms integral to feeding game birds and animals.					
5. Identify specific species as being omnivores, herbivores, or carnivores.					
6. Identify common foodstuffs eaten by specific species of wildlife.					
596					597

ISBE 41-78 (1/88)

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Feeding Game Birds and Animals

STUDENT LEARNING OBJECTIVES

Upon completion of their study of this problem area, students will be able to:

1. Define terms integral to feeding game birds and animals.
2. Identify specific species as being omnivores, herbivores, or carnivores.
3. Identify common foodstuffs eaten by specific species of wildlife.
4. Describe the relationship between foodstuffs and habitat for specific species of wildlife.
5. Adopt a personal philosophy concerning the advisability of providing food to wildlife by means of feeding stations.

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Feeding Game Birds and Animals

PROBLEMS AND QUESTIONS FOR STUDY **INSTRUCTOR'S NOTES AND REFERENCES**

1. What is an omnivore?
2. What is a carnivore?
3. What is a herbivore?
4. What species are omnivores?
5. What species are herbivores?
6. What species are carnivores?
7. What are the common foodstuffs of waterfowl?
8. What are the common foodstuffs of fur bearers?
9. What are the common foodstuffs of upland game birds?
10. What are the common foodstuffs of non-game birds?
11. What are the common foodstuffs of deer?
12. What are the advantages of providing food to game birds and animals?
13. What are the disadvantages of providing food to game birds and animals?
14. How can one provide food and water for wildlife?
15. How does food relate to habitat?
16. Why should one be concerned with feeding game birds and animals?
17. How can one determine the best means of providing food and water for a particular species?

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Feeding Game Birds and Animals

SUGGESTED TEACHING ACTIVITIES AND PROCEDURES

1. Use resource personnel from the Illinois Department of Conservation, Illinois Nature History Survey, U.S. Fish and Wildlife Service, Cooperative Extension Service, local landowners, local members of sporting clubs or preservation organizations, and others for specific information.

2. Use Information Sheet #1 as background information on the debate of providing supplementary food to wildlife. Lead students in a discussion of the merits of each side of the debate.

3. The problem areas, *Managing Game Preserves*, *Managing Hunting and Fishing Clubs*, and *Feeding Game Birds and Animals*, have been separated into individual areas for ease of delivery. One of the basic management concerns is to provide adequate foodstuffs for that wildlife present and to remedy deficiencies. The specific foods eaten by the identified species are presented in this problem area. *Managing Game Preserves* covers the fundamentals of manipulating and evaluating the habitat which is present. *Managing Hunting and Fishing Clubs* will address the additional requirements of these enterprises. It should be emphasized that separation is only for ease of delivery and that the topics are not divisible in actual practice. Any management scheme will address food and its provision in relation to the specific management object and the other habitat requirements.

4. Use Information Sheet #2 for specific foods eaten by the identified species. Information Sheet #3 identifies forage legume plants of benefit to specific species.

5. Use the referenced texts and publications for additional information on feeding game birds and animals.

6. Have students research a particular species and devise a plan for providing supplementary food for that species. Identify concerns such as specific food provided, method of feeding (scattering vs. feeders), location of feeding site, prey animals, etc. An extension activity would be to plan what manipulations of the habitat (plantings, cuttings, etc.) can be taken to provide for a permanent increase in the food available.

7. Arrange for a field trip to a local conservation Acres for Wildlife. Students can observe the different foods available and compile a list of likely users of that food.

8. Use the problem area *Conserving Wildlife Resources* as a reference for foodstuffs eaten by bobwhite quail, cottontail rabbits, mourning doves, tree squirrels, and ring-necked pheasants.

9. Lead students in a discussion of how the problem area *Feeding Game Birds and Animals* might be included in SAE, SOE, and FFA activities.

10. Use Transparency Master #1 as a guide for discussing what considerations to make when providing supplementary food for game birds and animals.

11. Have students compile lists of non-game species which consume foodstuffs similar to game species. This activity can be used to show that any provision for a target species will be used by non-target species as well.

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Feeding Game Birds and Animals

REFERENCES

INSTRUCTOR'S NOTES AND REFERENCES

*1. *More Wildlife for Recreation*. U.S. Department of Agriculture, Soil Conservation Service, Lincoln, NE.

*2. *Wildlife Conservation and Management Curriculum Guide for Vocational Agriculture/ Agribusiness (#1853)*. (1984). Louisiana Department of Education, Office of Vocational Education, Box 94064, Baton Rouge, LA 70804-9064.

*3. *Wildlife Management Techniques*. Giles, Robert A., ed. (1980). The Wildlife Society, Inc., Suite S176, 3900 Wisconsin Ave., N.W., Washington, DC 20016.

4. *Practical Wildlife Management*. Burger, G.V. (1973). Winchester Press, 460 Park Avenue, New York, NY 10022.

5. *Wildlife Management*. Giles, R.H., Jr. (1978). W.H. Freeman and Co., 4419 West 1980 S., Salt Lake City, UT 84104. (801) 973-4660.

*6. *Illinois Department of Conservation*. (Various publications and pamphlets).

7. *Introduction to Wildlife Management*. Shaw, J.H. (1985). McGraw-Hill, Publishing Co., Princeton Road, Nightstown, NJ 08520. (609) 426-5254.

8. *Wildlife Conservation Employee #0050*. Cooperative Training Course, IMS, Box 2588, Tesas A & M University, College Station, TX 77843-2588.

*Indicates highly recommended reference

601

INSTRUCTIONAL RESOURCES

These resources are intended for use by teachers in planning and teaching the materials for this problem area and may be adapted to fit the teaching method(s) used.

INFORMATION SHEET #1 — Feeding Wildlife

INFORMATION SHEET #2 — Wildlife Food

INFORMATION SHEET #3 — Plants for Wildlife

TRANSPARENCY MASTER #1 — Feeding Considerations

INFORMATION SHEET #1

Feeding Wildlife

Among those concerned with wildlife there exists a controversy surrounding the use of artificial means to provide the basic habitat requirements. This controversy, of course, extends to the area of feeding. One school promotes the idea that any attempt to manage or manipulate nature is wrong, or "unnatural." On the other side is the belief that, in most instances, the land has already been altered drastically by man's activities and that it is short-sighted not to employ all reasonable means to restore wildlife to those areas.

Supplementary feeding on a large scale has generally not been successful. In some instances it is not only feed that is lacking but also cover, and providing one will not make up for the other. In other instances, the feed provided is put in the wrong place (i.e. not near the necessary cover or along dangerous highways) and actually contributes to mortality.

There is general agreement that any efforts should be directed toward augmenting the natural habitat. It needs to be kept in mind that any artificial device is a temporary means of providing missing elements and not an end in itself. Commercial or home-built feeders and concrete watering holes should be viewed as stopgap measures until management of vegetation provides the needed food sources, and water maintenance projects are completed.

Supplemental food can be best utilized on a limited basis in a designated area. Feeding may be accomplished by scattering the feed on the ground or in the various types of feeders available. Scattering on the ground remains the cheapest method, and the feeding sites can be switched easily to minimize the concentration of predators at a fixed feeding location. Man-made feeders may provide for longer foodlife if they contain ventilation, and increased availability, since the food won't be frozen to the ground or covered with snow. However, they are harder to relocate. In addition, features such as size of feeding slots, durability, anchorability (to prevent spillage by animals or weather), and ease of refilling need to be considered.

Corn remains a favorite food for scattering on the ground because it is less prone to deterioration than the small grains and is easily visible. Cob corn is also good because it will not be covered by a light snowfall and most game species can pull kernels from the cob and drop enough for smaller wildlife to utilize. Chicken wire baskets can be constructed and filled with ear corn, then suspended from limbs to avoid snow and provide some weather protection.

By providing supplementary food to an otherwise useable location, man can have a positive effect on the wildlife population, if reason prevails. Food is only one of the basic necessities of a successful habitat and all other necessities must be evaluated. Whether the location be urban or rural and whether the need be from a bitter and prolonged winter or drought or the desire to bring animals to viewing range, the prime consideration needs to be the usefulness of the activity to the wildlife. Any feeding program needs to be geared toward the benefits to the target species.

C03

INFORMATION SHEET #2

Wildlife Food

Geese

Foods for geese are mostly vegetable in water. A goose feeds by tipping-up. The depth from which it can pull up water plants depends on the length of its neck. When of flight age, it prefers to feed on land where tender, green vegetation or waste grain may be found. Geese are primarily grazers of succulent green forage.

Preferred foods include alfalfa, barley, bluegrass, barnyardgrass, clovers, corn, fescue, millets, pondweed, rye, spike-rush, wheat, eelgrass, and widgeongrass. Other foods eaten are bromegrass, bulrush, cattail, oats, and smartweeds. They also like large insects, especially grasshoppers.

A young gosling's diet consists of plant life found near the waters where it was hatched.

Wild Turkey

Oak acorns of almost any type often make up 1/2 to 2/3 of the turkey's diet. Beechnuts, hickories, pecans, and seeds of ash and pines are also heavily used in some years. In some localities seeds from maple, elm, and birch, hazelnuts, greenbrier and hawthorn are used in considerable quantity. Bluegrasses and clovers are used extensively during the summer. A good turkey range has an adequate supply of water. Pits, ponds, and spring development are therefore recommended practices.

White-Tailed Deer

Studies indicate that a deer weighing 150 pounds needs at least 10 to 12 pounds of good browse daily to satisfy growth requirements; eight to ten pounds for maintenance. Food preferences vary with the season and region. Some foods are mountain maple, hemlock, white cedar, dogwood, red maple, mountain ash, willow, viburnums, wintergreen, sweetfern, poplar, greenbrier, alfalfa, clovers, acorns, and beechnuts. Foods such as oaks, cherries, balsam fir, alder, spruce, pines, tamarack, rhododendron, and laurel, when eaten alone and for a long duration, lead to starvation. Variety is essential for proper nutrition. Some plants are eaten heavily by deer but out of necessity instead of choice. In overpopulated areas choice foods are often browsed out of reach of does and fawns. Any browse over your head is out of reach for deer.

Muskrats

Cattails, bulrushes, burreed, rice cutgrass, and arrowhead are preferred foods. Other foods eaten are sedges, pondweeds, waterlily, panicgrass, and corn. There is minor use of animal foods such as fish, fresh water mussels, insects, crayfish, and snails, but the percentage is very low.

Ducks

In general, lack of food is not thought to be a limiting factor in waterfowl management during the production season. Abundant high-quality food, however, is essential on the wintering grounds so that healthy birds in good breeding condition will return to the production areas in the spring. Good food is also important in holding ducks in places where a long harvesting season is desired.

Feeding areas may be developed by diking relatively level land and installing a water control structure that will permit sufficient drainage for crop production. Duck foods like corn, browntop or other millets, or buckwheat are grown in the diked field. When the duck hunting season arrives, the diked field is flooded to a depth of 6 to 12 inches. This is done by releasing water from a nearby impoundment at a higher elevation, or by pumping from streams, canals, ponds, or wells.

The duck food plants must be left in a natural condition before flooding; they must not be cut, knocked down, or tampered with in any way.

Ducks should be harvested from feeding areas only in the morning. The birds should be allowed to feed undisturbed during the afternoon and evening.

Hungarian Partridge

The "Hun" is mainly vegetarian except for the first few weeks of life when it is insectivorous. Some important partridge foods are wheat, corn, barley, oats, smartweeds, bristlegrass seeds, bromegrass seeds, tareweed, alfalfa, clover, foxtail, bindweed, ragweed, and sometimes caragana seeds. In some localities waste grain may make up 90 percent or more of the food; it rarely drops below 30 percent.

Fall and winter coveys may number 20-30 birds. Fall and winter feeding is done primarily in grain and corn stubble and other harvested crop fields — usually the most exposed part of the landscape. Bitter cold weather holds no terror for the "Hun" for it is among the hardiest of our game birds. Burrowing in the snow is quite common.

The provision of special arrangements for winter food is not ordinarily needed, but leaving an uncut swath of durum wheat or a row or two of corn are excellent and simple ways to make a feeding area. Planting four rows of corn around the outside of a farm windbreak provides food and shelter in excellent relation to one another.

Opossum

The opossum is omnivorous and will eat almost anything. However, animal matter is preferred. Insects, dead animals, birds and their eggs, frogs, snails, and earthworms are all taken. Fruits are important in the diet only during the fall and early winter. Corn is eaten most commonly during the winter when other and perhaps more desirable foods are not available.

Striped Skunks

Striped skunks eat plant and animal foods in about equal amounts during fall and winter, but take more animal matter during spring and summer when insects, their preferred food, are more available. Bees, grasshoppers, and beetles are commonly eaten. Skunks also consume mice as well as young rabbits, ground squirrels, voles, birds, bird eggs, and toads. Plant foods include corn, black cherries, nightshades, and ground-cherries. In addition, carrion may be taken. Seasonal variation in the diet of skunks probably indicates that availability, accessibility, and abundance of certain food items are as important as preference in determining overall food habits.

Mink

The mink feeds upon mice, rabbits, and other terrestrial animals as does the weasel, and preys, like the otter, on fish, crayfish, and other aquatic species. Availability governs which animals are not commonly taken. Principal foods include frogs, mice and rats, fish, rabbits, crayfish, birds, squirrels, and muskrats. Miscellaneous items like spiders, snails, shrews, moles, bats, turtles and their eggs, snakes, bird eggs, grass, and leaves comprise the remainder of the diet.

Ordinarily, minks do not kill wantonly. Most food is carried to a den where it is consumed. The surplus is cached in or near the den, but frequently spoils and is not utilized.

Coyote

The majority of the coyote's food is composed of animal matter. Normally, rabbits and mice make up almost two-thirds of the diet. A study of the food habits of Missouri coyotes showed the following food groups and their percentages by volume: rabbits 53.7; mice and rats 8.7; other wild mammals 7.5; livestock 8.9; poultry 11.3; wild birds 0.5; known carrion 5.8; insects 0.8; plants 2.0; and miscellaneous 0.8. In Iowa, winter foods of coyotes were comprised by volume of 51 percent rabbits, 25.5 percent mice, 8.0 percent other mammals, 2.7 percent birds, 0.3 percent plants, and 0.2 percent miscellaneous. It is difficult to accurately evaluate the coyote's food habits since it is often impossible to determine whether the food was secured as a kill or eaten as carrion. About 15 percent of the total food of the coyote probably constitutes a financial loss to man while the remaining 85 percent is either neutral or beneficial.

Badgers

Badgers are strictly animal eaters, their most important foods being rabbits and rodents. Ground squirrels and woodchucks are a staple food during the year but become less available in fall when they go into hibernation. Mice of all kinds are sought and eaten, and form the majority of the diet when ground squirrels are not plentiful. Some cottontail rabbits are eaten year around; those taken in spring and summer are mostly young. Insects are consumed predominantly in late summer when the ground is dry and digging is difficult. Other animal foods such as moles, turtle eggs, beetles, grasshoppers, ground-nesting birds and their eggs, and snails are eaten when available.

The badger catches most animals alive but will take them as carrion. A badger prefers to drag a large animal into a burrow where it can eat leisurely in shelter. If no hole is sufficiently close by, one may be dug for the occasion. Surplus food is rarely cached.

Beavers

Beavers are strictly vegetarian in their food habits. They consume the bark of tender twigs and the new growth between the outer bark and the wood of branches and tree trunks. In the spring and summer they utilize many different kinds of vegetation such as roots of aquatic plants, marsh grasses, clover, and even certain berries. Corn is eaten where available. Beaver seem to prefer aspen, willow, birch, and poplar for food. Pine is seldom, if ever, used, but pine trees may be cut down and used for building purposes.

Woodcock

Two-thirds of the woodcock's animal diet, which averages about nine-tenths of all it eats, consists of earthworms. The balance includes flies, beetles, caterpillars, and grasshoppers. Plant foods include the seeds of sedge, blackberry, ragweed, and violet. "Feeding fields," visited in the morning and evening, vary in size and soil type and are always relatively open and easily accessible from the air. Many double as spring courtship grounds.

Non-Game Birds

Wild food patches

A small field can be managed to attract such seed-eating birds as snow buntings and redpolls (in northern states), goldfinches, tree sparrows, mourning doves, and juncos. No planting is necessary. Lay the field out in five strips. The width of each is not so important, but probably should not be less than 5 or greater than 30 feet. Each year plow a single strip in sequence such as 1-3-5-2-4 or 2-4-1-3-5. By repeating the sequence after the fifth year, shrub invasions are halted and strips of mixed vegetation are continually available to the birds. Favorite bird foods as bristlegrass, barnyardgrass, panic grasses, lambsquarter, ragweed, and smartweed will spring up the first year. One can expect a mixture of grasses, oxeye daisies, asters, goldenrods, black-eyed Susans, milkweeds, and others to vegetate in the plowed areas by the third year.

Planted food patches

Food patches planted for songbirds will attract the seedeaters. The size may range from 100 to 2,000 square feet or more. Pure stands of corn, grain, sorghum, millets, or sunflowers produce the most food, but a mixture of these attracts a greater variety of birds. The bristlegrasses and ragweeds which accompany cultivation are nutritious bird foods. All cultivation should be done on the contour to avoid soil erosion.

INFORMATION SHEET #3

Plants for Wildlife

Legumes

1. Sericea Lespedeza

Sericea lespedeza is a perennial legume which reaches a height of two-and-one-half to three feet. Small patches of sericea make excellent roosting, loafing, escape cover, and emergency food for bobwhite quail. Cottontails utilize sericea for both food and cover.

A strip of sericea lespedeza 6 to 15 feet wide, planted adjacent to a multiflora rose fence or other bushy fence row is an excellent practice. Other good sites are ditch banks, spoil banks, turnrows, and gullies. Sericea plantings established on these sites also provide excellent erosion control. Sericea seed should be sown immediately after danger of frost kill in the early spring. Scarified sericea lespedeza seed should be broadcast or drilled on a well-prepared seedbed and covered very lightly by dragging or rolling. A sericea planting unit (two pounds) will seed one-eighth acre (a strip 10 feet wide and 500 feet long). The application of 50 pounds of 1-12-12, or similar fertilizer per one-eighth acre is recommended at the time of seeding or as a top dressing after the seeds have germinated. Sericea is slow to become established and usually makes little growth in the first year. Do not become discouraged the first year. Seeding with Korean lespedeza the first year is a good practice because it provides ground cover during this period.

2. Japonica Lespedeza

Japonica lespedeza is a woody, bushy, perennial legume which reaches a height of six to ten feet when mature. Although Central Illinois is on the fringe of the area adapted for Japonica, good stands may be obtained when properly maintained. This plant produces quantities of seed and a cover which bobwhite quail relish; cottontails eat the bark and leaves. Japonica is shade tolerant so it can be planted along woodland borders, and in old plant beds. Odd corners of fields and power line rights-of-way are also excellent planting sites. Bobwhites receive the most benefit from plantings located near good cover. Japonica should not be planted where livestock can graze the planting.

Seed plantings should be made as soon as possible in early spring after danger of frost is past. Seed should be broadcast or drilled on a prepared seedbed at the rate of 15-20 pounds per acre. Plantings of 2,000 in four to six rows and long plantings along brush are preferred. Plantings should be maintained by cutting back the old canes about one foot from the ground with a mower, disc, or brush-axe during late winter when plants are dormant. Maintenance application of about 100 pounds of 3-12-12 or similar fertilizer per one-fourth acre is desirable for proper maintenance. These practices should be carried out every year to insure adequate and continuous seed production

3. Korean or Common Lespedeza

Korean lespedeza is an early, short growing, leafy annual legume. This plant has been extensively used as a pasture legume in Central and Southern Illinois. Korean lespedeza is palatable for all types of wildlife; the seed is a preferred quail food, and the plant is heavily grazed by rabbits. This plant will take hold and make a stand on infertile, eroded, acid soils where other legumes usually fail.

Seeding recommendations are generally the same as that of sericea lespedeza, with the exception that Korean lespedeza will establish when surface seeded in late winter. A good stand will persist and re-seed itself for several years as far north as Central Illinois.

4. Clovers — Sweet, Red, Ladino, Alsike

There are several varieties of clovers. They are essentially similar in that they are low-growing legumes, with the exception of sweet clover, which may reach a height of three to four feet or more. Clover is basically a pasture or hay crop, but provides very high-quality food utilized by our upland game species. In addition to food, they provide excellent nesting sites when sown with grasses or other legumes.

Strips of clover should be planted along shrub fences, field borders, woodland borders, shrub lespedeza strips, and in odd areas. Here they provide high-quality food within easy access to game and non-game species.

Clover should be sown at a rate of five to eight pounds per acre in a well-prepared seed bed, or may be interseeded in early spring or late winter by broadcasting on bare, frozen ground or on fall-planted wheat or other small grain. Application of fertilizer and limestone should be according to soil test. Seed should be broadcast and lightly covered by discing or rolling. Grazing should be prevented in plantings used for wildlife. When mowing, leave a strip eight to ten feet wide along the border, especially at the first and last cuttings each year.

5. Vetch

The use of hairy vetch is sometimes practical in areas of very low fertility, as a fast-growing cover crop. It is used as browse by rabbits, and the seed, though hard, is used by both quail and pheasant. One of the best values is in the fact that it falls in layers after frost and makes very good ground cover.

Illinois Department of Conservation
Division of Wildlife Resources

TRANSPARENCY MASTER #1

Feeding Considerations

1. Keep it Simple

2. Use Grain

3. Switch Locations Frequently

4. Check for Signs of Predation

5. Keep it Close to Cover

6. If You Start it, Continue It

TRANSPARENCY MASTER DISCUSSION GUIDE

Transparency Master #1

Use the list as a starting point to discuss the advantages and disadvantages of any type of feeding program.

1. Keep it simple — The simpler the design and method, the more likely it will be continued.

2. Use grain — Point out that food obtained in the wild is from the activities of vegetative growth. Grains are taken from scattered, lodged, or uncultivated production, so they are naturally to be chosen above commercially processed feeds such as poultry feed.

3. Switch locations frequently — This combines with keeping it simple, since prolonged feeding in one location will naturally encourage prey animals to congregate in that location.

4. Check for signs of predation — Even with switching locations, it is necessary to search for evidence of predation. Signs of predation may indicate only the normal course of the community, or they may indicate that the location is providing for more predation than would normally occur.

5. Keep it close to cover — One of the basic requirements of habitat is cover. Therefore, it makes sense, when providing food for wildlife, to do so in the context of habitat requirements such as cover. Arrange for the food to be within range of the cover, not in a place that is easiest for the provider to reach.

6. If You Start it, Continue It — It makes no sense to begin a program of providing food for wildlife, only to stop providing that food when the animals most need it. Times of prolonged or bitter weather, especially at the end of winter, are the times when wildlife, having become dependent on provided food, will need that food the most. These are also the times when providing that food is most inconvenient and most expense for the provider. Therefore, be aware of this situation before beginning a wildlife feeding program.

STUDENT ACTIVITIES

STUDENT WORKSHEET #1 — Wildlife Feed Survey

For additional activities, teachers may refer to the "Suggested Teaching Activities and Procedures" section in the Instructor's Guide.

STUDENT WORKSHEET #1

Wildlife Feed Survey

At the local feedsotre, hardware store, or animal supply dealer pick a wildlife feed available for two different species and answer the following questions:

Species	______________________	Species	______________________
Main Ingredients	______________ %		______________ %
	______________		______________
	______________		______________
	______________		______________
Recommended Feeding			
Time	________		________
Rates for Adults	________		________
Sizes Available	________		________
Costs Per Pound	________		________

Describe how the feed relates to the natural foods consumed by the species.

Ask a store employee the following questions:

1. What is the season in which the highest quantity of feed is purchased (fall spring, winter, summer, year round)?
2. What is the most prevelant reason for purchasing (customary, drought, hard winter, etc.)?

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Controlling Wildlife Pests

RELATED PROBLEM AREAS:

1. Stocking Fish
2. Managing Fish
3. Maintaining Wildlife Habitat
4. Raising Game Birds and Animals
5. Managing Game Preserves
6. Managing Hunting and Fishing Clubs
7. Conserving Wildlife Resources (Agricultural Business and Management)

PREREQUISITE PROBLEM AREA(S):

1. Classifying Fish
2. Classifying Game Birds and Animals

LEVEL: Preparatory

OCCUPATIONAL TASKS ADDRESSED:

Agricultural Resources Cluster

Duty A: Managing the Recreational Facility

1. Requisition materials, supplies, and services
2. Determine land-use capability
3. Assist in development of resource conservation plans

Duty B: Applying Laws, Regulations, and Policies

1. Interpret game and wildlife laws
2. Monitor camping and swimming areas

Duty C: Performing Promotional Activities

1. Give information and directions in a variety of formal and informal settings

Duty D: Managing Facility Flora and Fauna

1. Apply pesticides
2. Identify wildlife species within a selected area
3. Identify endangered or exotic species of plant and animal life in a selected area

Duty F: Using Tools, Material, and Equipment

1. Transport supplies using motorized wheeled or tracked equipment
2. Maintain grounds using power tools
3. Maintain grounds using power equipment

Duty G: Assembling, Servicing, and Maintaining Equipment and Facilities

1. Follow a facility and grounds maintenance schedule
2. Report facility and grounds maintenance needs
3. Inspect structures and conveniences needing maintenance
4. Maintain grounds and recreation areas
5. Maintain facility culverts
6. Maintain drainage ditches
7. Perform preventative and scheduled maintenance activities on grounds and facilities

Duty H: Applying Safety Practices

1. Implement plans to protect visitors from dangerous animals and other hazards
2. Implement plans to protect animals and plants and other resources from visitors

STATE GOALS FOR LEARNING

In planning the instruction for this problem area, teachers can promote the development of several student learning objectives which are related to the State Goals for Learning in Biological and Physical Sciences and Social Sciences. These objectives are listed on the Learning Assessment Plan forms included on the following page(s). Those learning objectives marked with an asterisk (*) are taken from the sample lists provided by the Illinois State Board of Education.

CORE

Illinois Agricultural Core Curriculum

Agricultural Education 124 Mumford Hall 1301 W. Gregory Drive University of Illinois Urbana, IL 61801

Director: Dale A. Law, Ed.D.
Principal Investigator: Jerry D. Pepple, Ed.D
Research Assistant: Robert E. Petrea

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

Submission Date ____________
☐ **Original submission** ☐ **Revision**
Page ____ of ____

I. LEARNING AREA *(check one)*
☐ Language Arts ☐ Fine Arts
☐ Mathematics ☒ Social Sciences
☐ Sciences ☐ Physical Development/Health

(Affix label or complete district information.)

COUNTY	DISTRICT	ESC

District Name

City

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will be able to apply the skills and knowledge gained in the social sciences to decision making in life situations.

Contact Person: ____________
Title: ____________
Phone: (   )

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Understand the knowledge and skills required for success in selected fields of work.					
*2. Recognize that competence in a field of work entails the development of a wide range of skills.					
3. Differentiate between a problem animal and a useful species.					
4. Explain the approaches used in controlling wildlife pests and suggest ways to minimize problems caused by those pests.					
615					616

Submission Date ____________
☐ **Original submission** ☐ **Revision**
Page ____ of ____

I. LEARNING AREA *(check one)*
☐ Language Arts ☐ Fine Arts
☐ Mathematics ☐ Social Sciences
☒ Sciences ☐ Physical Development/Health

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

(Affix label or complete district information.)

COUNTY	DISTRICT	ESC

District Name

City

Contact Person: ____________
Title: ____________
Phone: (   )

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will have a working knowledge of the social and environmental implications and limitations of technological change.

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Identify materials now in use that are replacing natural resources.					
*2. Formulate positions on environmental issues after consideration of available scientific information.					
3. Describe specific control techniques for various wildlife species.					
4. Explain the approaches used in controlling wildlife pests and suggest ways to minimize problems caused by those pests.					
5. Differentiate between a problem animal and a useful species.					

ISBE 41-78 (1/88)

Illinois Agricultural Core Curriculum Rev.

Controlling Wildlife Pests

Agricultural Resources
Fish and Wildlife Management

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

Submission Date ____________________
☐ **Original submission** ☐ **Revision**
Page ____ of ____

I. LEARNING AREA *(check one)*
☐ Language Arts
☐ Mathematics
☒ Sciences
☐ Fine Arts
☐ Social Sciences
☐ Physical Development/Health

(Affix label or complete district information.)
COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐
District Name
City

II. STATE GOAL FOR LEARNING
As a result of their schooling, students will have a working knowledge of the concepts and basic vocabulary of biological, physical, and environmental sciences and their application to life and work in contemporary technological society.

Contact Person: ____________________
Title: ____________________
Phone: ( )

III. LEARNING OBJECTIVES

By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:

III. LEARNING OBJECTIVES	IV. ASSESSMENT A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	V. EXPECTATIONS Percent of Students Expected to Achieve Objective
*1. Understand the interactions among populations of plants, herbivores, and carnivores.					
*2. Understand that an ecosystem consists of a community interacting with its physical environment.					
3. Define terms integral to controlling wildlife pests.					
4. Describe various problems caused by wildlife pests.					
5. Identify specific problems caused by various wildlife species.					
6. Differentiate between a problem animal and a useful species.					
					620
619					

ISBE 41-78 (1/88)

Agricultural Resources
Fish and Wildlife Management

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Controlling Wildlife Pests

STUDENT LEARNING OBJECTIVES

Upon completion of their study of this problem area, students will be able to:

1. Define terms integral to controlling wildlife pests.
2. Describe various problems caused by wildlife pests.
3. Identify specific problems caused by various wildlife species.
4. Describe specific control techniques for various wildlife species.
5. Explain the approaches used in controlling wildlife pests and suggest ways to minimize problems caused by pests.
6. Differentiate between a problem animal and a useful species.

INSTRUCTOR'S NOTES AND REFERENCES

621

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Controlling Wildlife Pests

PROBLEMS AND QUESTIONS FOR STUDY	**INSTRUCTOR'S NOTES AND REFERENCES**
1. What is a wildlife pest?	
2. What are some feline species of wildlife pests?	
3. What are some canine species of wildlife pests?	
4. What are some avian species of wildlife pests?	
5. What are some rodent species of wildlife pests?	
6. What kinds of problems are caused by wildlife pests?	
7. What are specific problems caused by feline pests? Canine? Avian? Rodent?	
8. What are the various control techniques available for wildlife pests?	
9. Which techniques should one use to control feline pests? Canine? Avian? Rodent?	
10. What are the various approaches used to control wildlife pests?	
11. How can one minimize problems caused by wildlife pests?	
12. How can one tell the difference between a problem animal and a useful species?	
13. Why should one be concerned with the difference between a useful species and a problem animal?	

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Controlling Wildlife Pests

SUGGESTED TEACHING ACTIVITIES AND PROCEDURES

1. Use resource personnel from the local office of the Cooperative Extension Service, the Illinois Department of Conservation, Illinois Natural History Survey, U.S. Fish and Wildlife Service, local landowners, a city or county animal control officer, or local professional trappers for specific information.

2. Use the problem area in conjunction with *Managing Game Preserves*, *Managing Hunting and Fishing Clubs*, and *Raising Game Birds and Animals* for information concerning the control of pests in those different enterprises.

3. Use Information Sheet #1 as a guide for techniques to use in controlling specific wildlife pests.

4. Invite the local animal control officer to give a class demonstration on the various techniques used in the removal of offending animals.

5. Invite a Department of Conservation law enforcement officer to address the class on regulations regarding wildlife pests in general and licensing requirements for possessing specific wild animals. Ask the officer to explain the procedures to follow in live trapping of an offending raccoon out of season.

6. Use Information Sheet #2 as a basis for leading a class discussion on the topic of how many animals are a pest and nuisance in one particular situation but serve a useful and necessary role in the wildlife community.

7. Use the referenced texts and publications for additional information on controlling wildlife pests.

8. Use Transparency Master #1 to lead a class discussion on the four basic approaches to controlling wildlife pests. Use the Transparency Master Discussion Guide for additional information.

9. Use Transparency Master #2 for examples of the prevention approach to controlling wildlife pests. Ask students to cite personal experiences with wildlife control.

10. Use Transparency Masters #3 - 6 for examples of control and removal techniques.

11. Have a student that traps or a local trapper give a demonstration of the different types of traps, techniques for using those traps, and specific live traps for various animals.

12. Obtain copies of "Fur Trapping and the Fur Trade in Illinois," IDOC, Division of Wildlife Resources, 600 North Grand Avenue West, Springfield, IL 62706, (217) 782-6384. This pamphlet can be used in conjunction with discussions of Transparency Masters #3, 4 and 6.

13. Obtain copies of IMS #8985-B, *Predator and Pest and Nuisance Species Identification*, for use as a study text with study guide.

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Controlling Wildlife Pests

REFERENCES **INSTRUCTOR'S NOTES AND REFERENCES**

*1. *Wildlife Conservation Employee* (#0050); *Predator and Pest and Nuisance Species Identification* (#8985-B); *Handling Misplaced Wildlife* (#8987-D). Instructional Material Service, Texas A & M, Box 2588, College Station, TX 77843-2588.

*2. *A Guide to Urban Wildlife Management*. Leedy, D.L., Adams, L.W. (1984). National Institute for Urban Wildlife, 10921 Trotting Ridge Way, Columbia, MD 21044.

*3. *Wildlife Management Techniques*. Giles, Robert A., ed. (1980). The Wildlife Society, Inc., Suite 5116, 3900 Wisconsin Avenue, N.W., Washington, DC 20016.

4. Illinois Department of Conservation. (Various publications). Information and Education, Lincoln Towers, Suite 100, 524 South Second Street, Springfield, IL 62706.

5. *Introduction to Wildlife Management*. Shaw, J.H. (1985). McGraw Hill, Inc., 13955 Manchester Road, Manchester, MO 63011. (314) 256-2300.

*6. *Trapper Training - Natural History* (962-X); *Trapper Training - Furbearer Management* (962-X). (Color slides and script). Ohio Agricultural Education Curriculum Materials Service, 2120 Fyffe Road, Room 254, Ohio State University, Columbus, OH 43210. (614) 292-4848.

*Indicates highly recommended reference

INSTRUCTIONAL RESOURCES

These resources are intended for use by teachers in planning and teaching the materials for this problem area and may be adapted to fit the teaching method(s) used.

INFORMATION SHEET #1 — Techniques to Use in Controlling Specific Wildlife Pests

INFORMATION SHEET #2 — Bad Animal But Good Species?

TRANSPARENCY MASTER #1 — Approaches to Control (with discussion guide)

TRANSPARENCY MASTER #2 — Preventing Access (with discussion guide)

TRANSPARENCY MASTER #3 — Traps for Fur Bearers (with discussion guide)

TRANSPARENCY MASTER #4 — Runway Trap (with discussion guide)

TRANSPARENCY MASTER #5 — Bait Boxes (with discussion guide)

TRANSPARENCY MASTER #6 — Snare and Exploder (with discussion guide)

INFORMATION SHEET #1

Techniques to Use in Controlling Specific Wildlife Pests

After pest damage has occurred in an area, signs will be left to indicate the species that may have been involved. For instance, gophers and mice damage roots of plants, whereas squirrels and chipmunks damage buds. Coyotes will bite holes in melons and eat the center out, whereas raccoons will make small holes and scoop out the pulp with the front paws. Foxes normally consume only the breast and upper legs of birds and scatter the remaining body parts about, whereas an opossum will consume the entire bird leaving only wet feathers.

Being able to identify the offending animal by way of "signs" requires time and experience and is still difficult. The most reliable way, of course, is to actually observe the animal in action. Once the animal is seen or enough evidence is gathered to positively identify the specific cause of the damage, the following may be used as a guide for control techniques to consider.

It must be remembered that all wildlife are considered property of the State of Illinois and that many of the following have specific hunting seasons and hours of hunting; hunting them requires a hunting license. In addition, to hold, propagate, or sell any animal not covered by the game protection regulations, a permit is required. Consult the Illinois Department of Conservation for specific regulations.

Chipmunks — Snap traps, live traps, toxic grain baits.

Mice — Proofing and screening, habitat modification, snap traps, live traps, toxic grain baits.

Moles — Harpoon and scissor traps, insecticides (remove food source), habitat modification, toxic baits.

Muskrat — Conibear traps, leghold traps (#0 - 2), live traps, habitat modification, anticoagulants.

Gophers — Pocket gopher traps, fumigants, grain bait, habitat modification (flooding).

Rabbits — Habitat modification, fencing and proofing, repellents, live traps, body snares, shooting, baits.

Squirrels — Fencing and proofing, repellents, live traps, shooting, conibear traps, leghold traps (#0 - 2).

Ground Hogs — Fumigants, leghold traps (#1 ½ - 2), shooting, toxic baits.

Coyotes, Wolves, and Dogs — Fencing, den hunting, shooting, leghold traps (#3 - 4 ½).

Foxes — Leghold traps (#2 - 3), shooting, fencing, snares.

Opossum — Live traps, fencing, shooting, leghold traps (#1 - 1 ½).

Raccoon — Live traps, leghold traps (#2 - 3), fencing, shooting.

Skunks — Live traps, shooting, leghold traps (#1 - 1 ½)

Cats — Live traps, shooting, leghold traps (#1 - 1 ½).

Pigeons — Mechanical frightening, traps, proofing, screening, chemical frightening agents.

Sparrows — Trapping, toxic bait, chemical frightening agents, shooting, proofing and screening, habitat manipulation.

Starlings — Habitat manipulation, trapping, proofing and screening, mechanical and chemical frightening agents, shooting.

INFORMATION SHEET #2

Bad Animal But Good Species?

When a single animal of a particular species causes a problem, we tend to associate that problem with the species as a whole. Whether the problem is a mouse in the house, a raccoon in the attic, definite coyote tracks around a white tailed deer you were eyeing for November, or perhaps a fox seen in the favorite quail brush, a feeling grows that if we could eliminate all of the species we don't like we would be better off. While a mouse under the stove warrants elimination from that spot, it does not follow that no mouse ever did any good anywhere. (Mice are omnivorous and opportunistic and eat such things as insects and spiders which some find more offensive.)

The feeling toward a particular species is especially strong in relation to predator species. Most feel that if the predator were eliminated, the prey species would flourish. Such is simply not the case. The number of prey present actually controls the number of predators present.

Because you have expended effort to improve the suitability of habitat for quail and have actually increased the carrying capacity of the habitat, thereby increasing the number of quail present, it is reasonable to assume that more feral dogs, foxes, feral cats, etc., will be attracted to the area because of the food supply. Now, if a fox shows up to take advantage of the situation, several items need to be considered:

1. Prey have been eaten by predators for years but have not been eliminated by the predator species.
2. Even if the steps are taken to eliminate the fox, which may or may not be warranted, and the fox is eliminated, then other meat eaters, such as raccoon and skunk, will increase in number.
3. The niche filled by a particular species or by a particular class (meat eaters) is necessary in the long run, and its elimination will cause even more problems.
4. If in the provision for the habitat requirements, enough attention has been given to cover, then the prey species will not be seriously hurt by the predator.

The main idea is that while the removal of a particular animal or breeding pair may be economically justified at one location or farm, the objective is to rid the location of the **offending** animal(s). It is not true that the entire species is of no benefit and deserves elimination. If a gopher is tunneling up the prized petunia bed, or if a raccoon has taken up residence in grandmother's attic, by all means some steps need to be taken. It may be as simple as setting a trap on the gopher run, or it may require the services of a professional to remove the raccoon without it causing more damage. Remove the offending animal and take any steps that will help prevent an additional occurrence, but don't hate the next one you see. The animal might only be doing its job!

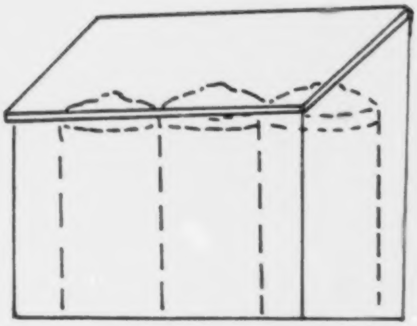
TRANSPARENCY MASTER #1

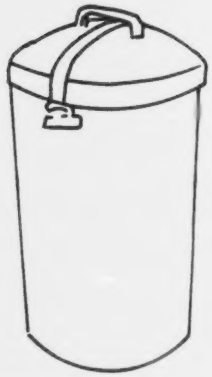
Approaches to Control

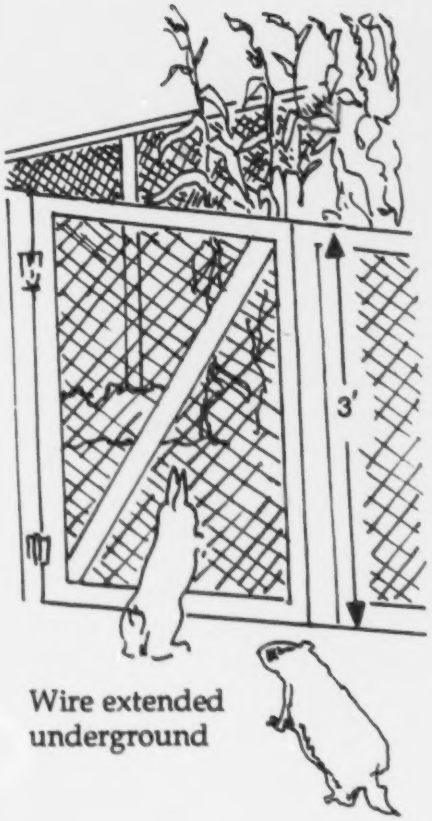
1. Elimination of one or more habitat requirements
2. Preventing access
3. Use of repellents
4. Removal of the animal(s)

TRANSPARENCY MASTER #2

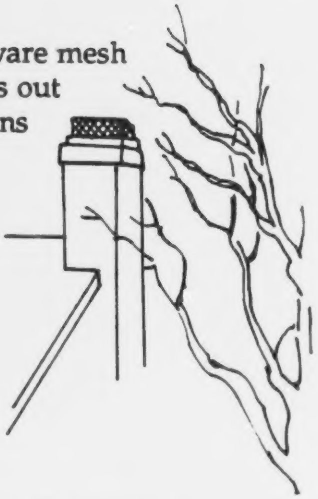
Preventing Access







Wire extended underground



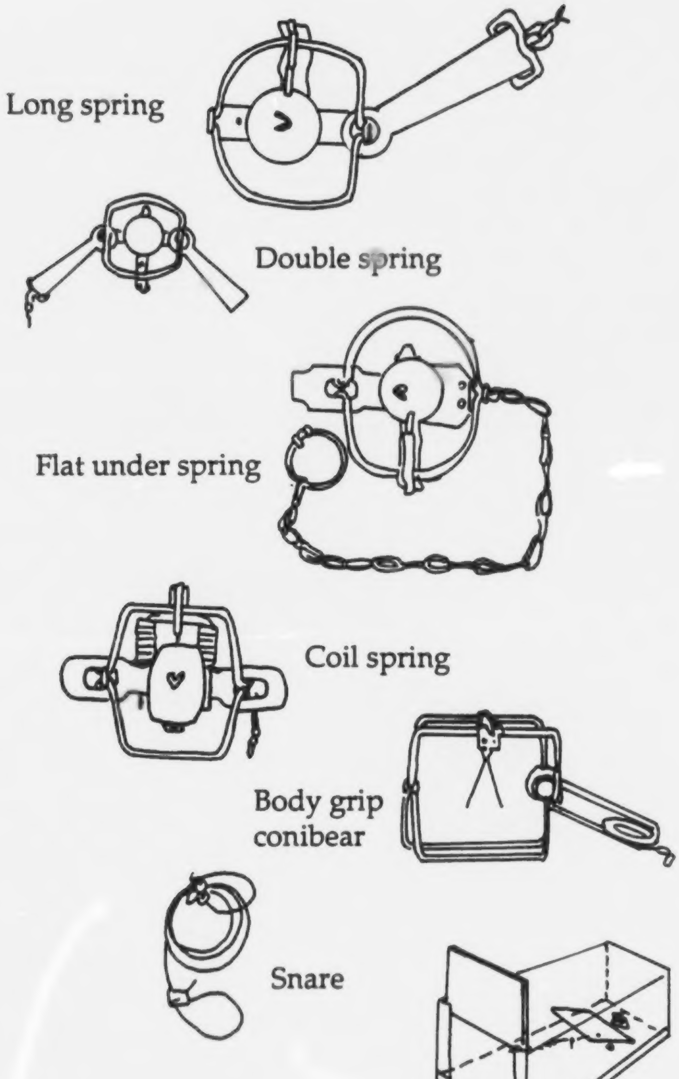
Hardware mesh screens out raccoons

Trim access limbs-keep animals off roof

639

TRANSPARENCY MASTER #3

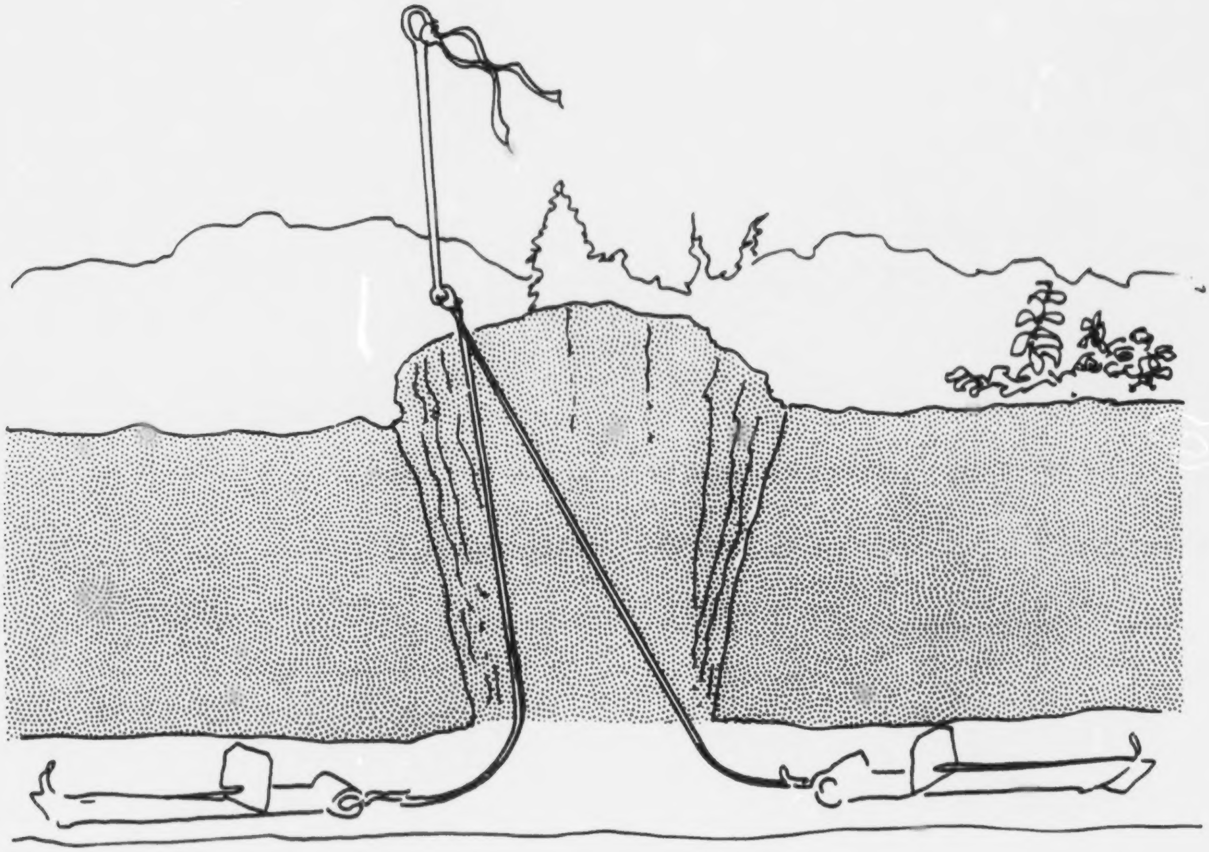
Traps for Fur Bearers


Long spring
Double spring
Flat under spring
Coil spring
Body grip conibear
Snare
Box or live trap

Illinois Department of Conservation

TRANSPARENCY MASTER #4

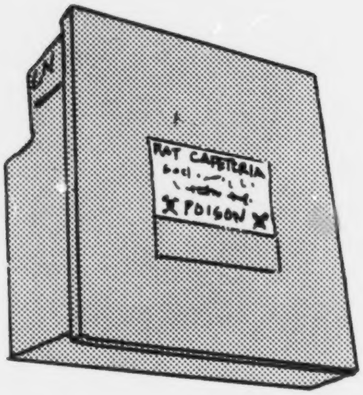
Runway Trap

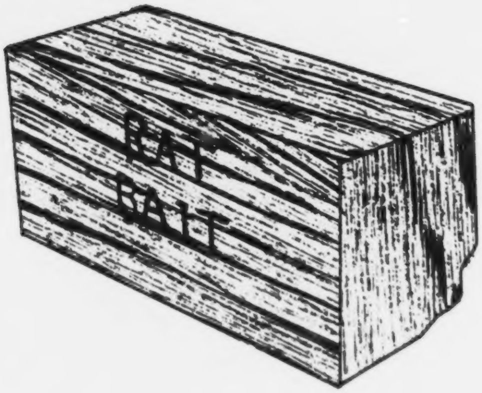


After excavating the main runway, traps are set — one in each direction. Stakes help locate the sets and anchor the traps so they will not be lost.

TRANSPARENCY MASTER #5

Bait Boxes


RAT CAFETERIA
POISON

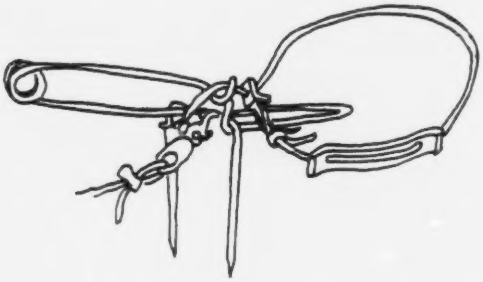


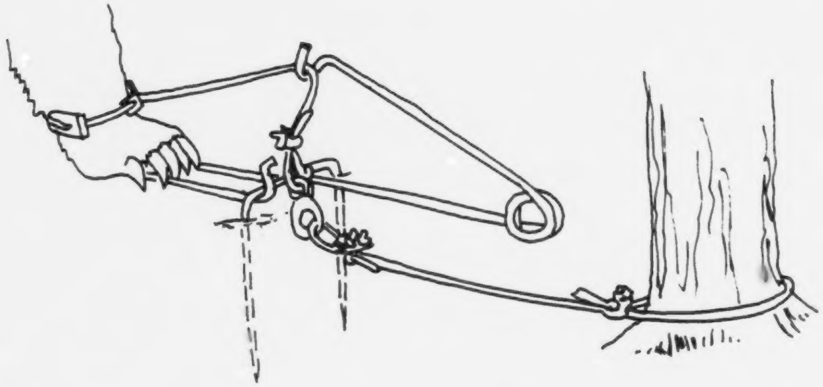
A. Commercial

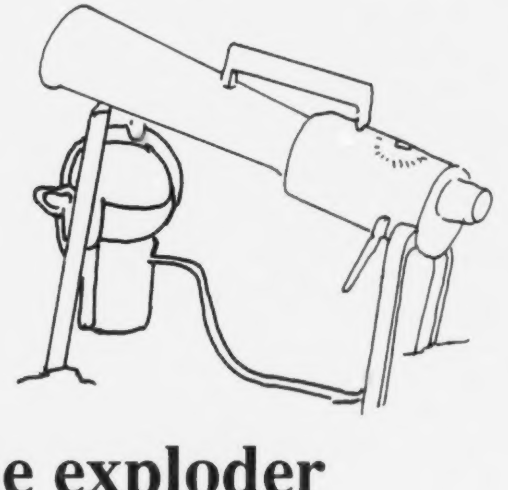
B. Homemade

TRANSPARENCY MASTER #6

Snare and Exploder







Propane exploder

TRANSPARENCY MASTER DISCUSSION GUIDE

Transparency Master #1

The various approaches available should be used in a fashion that will cause the least disturbance to the other wildlife present.

1. This approach would be most applicable in urban or suburban areas where one specific site can be determined. The elimination of food, water, cover, space, and arrangement will, of course, have an effect on desirable wildlife. Thus, the practicality of this approach is substantially lessened in rural areas except for those species with highly refined habitat requirements. A decision will have to be made concerning the importance of the pest in relation to the effect on the remaining wildlife, and whether a different approach would be more desirable.

2. This approach may be directly related to #1 if by preventing access to the damage area, one of the habitat requirements has to be eliminated (food or cover for instance). General examples:

    a. Elimination of exposed beams, ledges, unscreened ventilation in building designs. Screening of openings in present buildings (ventilation, chimneys, fans, etc.), lids on trash cans.

    b. Installation of fencing around gardens, flower beds, trash containers, young fruit trees, etc., may need to be tall (deer) or extended underground for burrowing animals.

3. Repellents may be chemicals applied directly to plants to reduce palatability and desirability or to specific areas such as ledges or beams to cause physical discomfort. Fumigants are effective against burrowing animals, but are dangerous to handle and non-specific in targets. Toxicants, such as anticoagulants, may require multiple doses. Other toxicants, such as zinc phosphide, may require only a single application.

4. Trapping, poisoning, or shooting of the offending animal involves legal requirements which may have to be observed in some cases of firearms and traps. Poisons may be commercially available for convenient use, but may or may not be desirable because of the agent used and the presence of other animals within the placement areas. Family pets and livestock considerations need to be made. Live trapping is an alternative, but expertise in the traps themselves and the particular animal's habits are needed, and permits are required for possession. Mechanical devices for frightening animals, such as exploders, are available but must be moved often and the interval between explosions must be changed.

Transparency Master #2

1. Lead students in a discussion of how the examples shown can eliminate or reduce wildlife damage.

2. Have students give examples of personal experience with animal damage and the actions taken.

Transparency Master #3 — 6

1. Use these examples to generate student discussion on their opinions of trapping in general and its use in problem animal removal in particular.

2. Have students cite personal experience with chemical repellents and toxic baits.

3. Point out that the use of *snares* is illegal in the state of Illinois.

634

STUDENT ACTIVITIES

STUDENT WORKSHEET #1 — Wildlife Pests

For additional activities, teachers may refer to the "Suggested Teaching Activities and Procedures" section in the Instructor's Guide.

STUDENT WORKSHEET #1

Wildlife Pests

1. Define predator.
2. Define a nuisance.
3. Define a pest.
4. Name six animal control methods.
5. What functions do predators perform?
6. Name four predator species.
7. Describe how a nuisance animal may belong to a necessary species.
8. Identify two areas at your home that have provided sites where pests have lived.

STUDENT WORKSHEET #1 — Key

Wildlife Pests

1. Define predator. *Animal species that kill and eat other animals.*

2. Define a nuisance. *An animal species considered unpleasant or bothersome.*

3. Define a pest. *An animal species that can cause harm to humans.*

4. Name six animal control methods. *Shooting, trapping, frightening, habitat modification, poisoning, and screening.*

5. What functions do predators perform? *A. control prey populations, B. contribute to prey genetics by eliminating weaknesses.*

6. Name four predator species. *Answers will vary. Point out the definition can include birds, insects, reptiles, snakes, and spiders besides the common carnivores.*

7. Describe how a nuisance animal may belong to a necessary species. *Refer to Information Sheet #2.*

8. Identify two areas at your home that have provided sites where pests have lived. *Answers will vary. Birds and rodents are the most common pests besides flys and insects.*

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Raising Game Birds and Animals

RELATED PROBLEM AREAS:

1. Classifying Game Birds and Animals
2. Feeding Game Birds and Animals
3. Controlling Wildlife Pests
4. Maintaining Wildlife Habitat
5. Managing Game Preserves
6. Maintaining Animal Health (Agricultural Business and Management Cluster)
7. Meeting the Environmental Requirements of Animals (Agricultural Business and Management Cluster)

PREREQUISITE PROBLEM AREA(S):

1. Understanding Animal Anatomy and Physiology (Agricultural Business and Management Cluster)
2. Identifying Basic Principles of Animal Science (Central Core Cluster)

LEVEL: Preparatory

OCCUPATIONAL TASKS ADDRESSED:

Agricultural Resources Cluster

Duty A: Managing the Recreational Facility

1. Requisition materials, supplies, and services
2. Maintain inventory records
3. Maintain equipment maintenance records
4. Follow work schedule

Duty B: Applying Laws, Regulations, and Policies

1. Interpret game and wildlife laws
2. Maintain permits, certificates, and licenses
3. Prepare service work order
4. Estimate cost of service work

Duty D: Managing Facility Flora and Fauna

1. Identify wildlife species within a selected area

Duty E: Performing General Office Work

1. File materials, such as receipts, letters, documents, specifications, and orders

Duty G: Assembling, Servicing, and Maintaining Equipment and Facilities

1. Follow a facility and grounds maintenance schedule
2. Trouble-shoot equipment failure

STATE GOALS FOR LEARNING

In planning the instruction for this problem area, teachers can promote the development of several student learning objectives which are related to the State Goals for Learning in Biological and Physical Sciences and Social Sciences. These objectives are listed on the Learning Assessment Plan forms included on the following page(s). Those learning objectives marked with an asterisk (*) are taken from the sample lists provided by the Illinois State Board of Education.

CORE

Illinois Agricultural Core Curriculum

Agricultural Education 124 Mumford Hall 1301 W. Gregory Drive University of Illinois Urbana, IL 61801

Director: Dale A. Law, Ed.D.
Principal Investigator: Jerry D. Pepple, Ed.D.
Research Assistant: Robert E. Petrea

90/91

Submission Date ____________

☐ Original submission ☐ Revision

Page ____ of ____

I. LEARNING AREA *(check one)*

☐ Language Arts ☐ Fine Arts
☐ Mathematics ☒ Social Sciences
☐ Sciences ☐ Physical Development/Health

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

(Affix label or complete district information.)

COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐

District Name

City

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will be able to apply the skills and knowledge gained in the social sciences to decision making in life situations.

Contact Person: ____________

Title: ____________

Phone: (   )

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Understand the knowledge and skills required for success in selected fields of work.					
*2. Recognize that competence in a field of work entails the development of a wide range of skills.					
3. State specific requirements for successfully raising rabbits.					
4. State specific requirements for successfully raising pheasants.					

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

Submission Date ____________
☐ **Original submission** ☐ **Revision**
Page ____ of ____

I. LEARNING AREA *(check one)*
☐ Language Arts
☐ Mathematics
☐ Sciences
☐ Fine Arts
☒ Social Sciences
☐ Physical Development/Health

(Affix label or complete district information.)

COUNTY	DISTRICT	ESC

District Name
City

Contact Person: ____________
Title: ____________
Phone: (   )

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will be able to demonstrate a knowledge of world geography with emphasis on the United States.

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Understand how habitats have been modified by human activity.					
2. Summarize the similarities and differences between the environment of captive-reared and wild-reared game birds and animals.					

Raising Game Birds and Animals

Illinois Agricultural Core Curriculum Rev.

Agricultural Resources
Fish and Wildlife Management

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

Submission Date ____________________
☐ Original submission ☐ Revision
Page ____ of ____

I. LEARNING AREA *(check one)*
☐ Language Arts ☐ Fine Arts
☐ Mathematics ☐ Social Sciences
☒ Sciences ☐ Physical Development/Health

(Affix label or complete district information.)

COUNTY	DISTRICT	ESC

District Name

City

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will have a working knowledge of the social and environmental implications and limitations of technological development.

Contact Person: ____________________
Title: ____________________
Phone: ( )

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Identify materials now in use that are replacing natural resources.					
2. Relate the requirements of raising rabbits to other fur-bearing game species.					
3. Relate the requirements of raising pheasants to other avian game species.					
4. State specific requirements for successfully raising rabbits.					
5. State specific requirements for successfully raising pheasants.					

ISBE 41-78 (1/88)

Submission Date ____________________

☐ **Original submission** ☐ **Revision** Page ____ of ____

I. LEARNING AREA *(check one)*

☐ Language Arts ☐ Fine Arts

☐ Mathematics ☐ Social Sciences

☒ Sciences ☐ Physical Development/Health

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

(Affix label or complete district information.)

COUNTY	DISTRICT	ESC

District Name

City

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will have a working knowledge of the concepts and basic vocabulary of biological, physical, and environmental sciences and their application to life and work in contemporary technological society.

Contact Person: ____________________

Title: ____________________

Phone: (   )

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Understand the interactions among populations of plants, herbivores, and carnivores.					
*2. Support the statement that living things receive their characteristics from the parent organism.					
*3. Recognize that populations of plants and animals change as the environment changes.					
4. Define terms integral to raising game birds and animals.					
5. State specific requirements for successfully raising rabbits.					
6. State specific requirements for successfully raising pheasants.					

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Raising Game Birds and Animals

STUDENT LEARNING OBJECTIVES

Upon completion of their study of this problem area, students will be able to:

1. Define terms integral to raising game birds and animals.
2. Describe licensing requirements to legally raise game birds and animals.
3. State specific requirements for successfully raising rabbits.
4. Relate the requirements of raising rabbits to other fur-bearing game species.
5. State specific requirements for successfully raising pheasants.
6. Relate the requirements of raising pheasants to other avian game species.
7. Summarize the similarities and differences between the environment of captive-reared and wild-reared game birds and animals.

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Raising Game Birds and Animals

PROBLEMS AND QUESTIONS FOR STUDY

1. What licenses are required to possess and raise game birds and animals?
2. Where does one obtain an application for a permit to raise game birds and animals?
3. What are the requirements for successfully raising rabbits?
4. Where can one obtain information on raising rabbits?
5. Why should one be aware of the relationships between raising rabbits and other fur-bearing animals?
6. What are the relationships between raising rabbits and other fur-bearing game animals?
7. What are the specific requirements for successfully raising pheasants?
8. What are the relationships between raising pheasants and other avian game animals?
9. Why should one be aware of the relationships between raising pheasants and other avian game species?
10. What are the similarities in the environment between captive-reared and wild-reared game birds?
11. What are the differences in the environment between captive-reared and wild-reared game birds?
12. What are the similarities in the environment between captive-reared and wild-reared fur bearers?
13. What are the differences in the environment between captive-reared and wild-reared fur bearers?
14. Why is it important that one understands the natural environment of game birds and animals?
15. How does the natural environment of a game bird or animal affect the techniques of rearing that species in captivity?

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Raising Game Birds and Animals

SUGGESTED TEACHING ACTIVITIES AND PROCEDURES

1. Use personnel from the Cooperative Extension Service, the Illinois Department of Conservation, local sportsman clubs, game preserve and hunting preserve operators, state game farms, or local game hobbyists for more species-specific information.

2. Use problem areas, *Maintaining Wildlife Habitat*, *Meeting the Environmental Requirements of Animals*, and *Maintaining Animal Health* as resources for specific information on principles associated with these areas of raising animals.

3. Plan a field trip to a local producer or a state game farm. Contact the local or state office of the Department of Conservation for the location of the nearest state farm. Areas of interest during the visit would include:

   Species raised
   Record system
   Feed source and type
   Equipment used
   Facility type
   Management of young
   Incubation and hatching of eggs
   Disease treatment and prevention methods
   Mating method and ratios

4. Invite a member of a local sportsman club or game animal hobbyist to make a presentation to the class on the various aspects of obtaining, raising, and marketing the specific species.

5. Use Information Sheet #1 in conjunction with Transparency Master #1 for information concerning the permit required in the State of Illinois to hold, possess, or raise wild animals. Invite a Department of Conservation law enforcement official to address the class for more explicit information.

6. Use Information Sheet #2 for information on raising rabbits. Lead students in a discussion of the similarities and differences in raising rabbits compared to other fur-bearing animals. Use the reference list for sources of additional information.

7. Use Information Sheet #3 for information on raising pheasants. Lead students in a discussion of the similarities and differences in raising pheasants compared to other avians such as quail or mallard ducks.

8. Use Information Sheet #4 on incubation as a resource for students in recognizing the management concerns in hatching fowl species.

9. Use Information Sheet #5 on sexing ring neck pheasant chicks to expose students to a management technique to separate male and female chicks.

10. Obtain copies of the text "Game Bird Propagation" for use as a student reference. This text covers the propagation techniques associated with game birds and addresses all management concerns. Included are extensive lists of game bird references and suppliers of equipment and material. Also available from Wildlife Harvest Publications is a game cookbook which could be used as a source of recipes for cooking game birds and animals raised as a classroom or individual project.

11. Encourage students to consider raising game birds and animals as an SAE or SOE project. An FFA Chapter could consider raising game birds or animals as a chapter activity in conjunction with a game preserve or sportsman club.

12. Use Student Worksheet #1 in conjunction with Information Sheet #1 and Student Worksheet #2 in conjunction with Information Sheet #2.

13. Use the problem area, *Identifying and Using Agricultural Organizations, Agencies, and Sources of Information About Agriculture*, as a reference for addresses of specific species organizations within Illinois that deal with mink, foxes, rabbits, wild turkeys, and others.

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Raising Game Birds and Animals

REFERENCES

INSTRUCTOR'S NOTES AND REFERENCES

*1. *Game Bird Propagation*. (1987). Mullin, J.M. Wildlife Harvest Publications, P.O. Box 96, Gooselake, IA 52750. (319) 242-3046.

*2. *Specialty Animal Production Curriculum Guide for Vocational Agriculture/Agribusiness*. (1987). Bulletin #1806. Louisiana Department of Education, Office of Vocational Education, P.O. Box 94064, Baton Rouge, LA 70804-9064.

3. *Rabbit Production*. (Filmstrips with cassettes). (1982). Cheeke, P.R., Patton, N.M., Templeton, G.S. Interstate Publishers, Inc., P.O. Box 50, Danville, IL 61834-0050. (217) 446-0500.

4. *Rabbits (#1-470-231C), An Introduction to Game Birds, Brooding of Game Birds*. Vocational Education Productions, California Polytechnic State University, San Luis Obispo, CA 93407.

*Indicates highly recommended reference

651

INSTRUCTIONAL RESOURCES

These resources are intended for use by teachers in planning and teaching the materials for this problem area and may be adapted to fit the teaching method(s) used.

INFORMATION SHEET #1 — Game and Game Bird Breeders - Necessity of Permit

INFORMATION SHEET #2 — Raising Rabbits

INFORMATION SHEET #3 — Raising Pheasants

INFORMATION SHEET #4 — Incubation

INFORMATION SHEET #5 — Sexing Day-Old Ringnecks

TRANSPARENCY MASTER #1 — Sample Application for Wild Game and Bird Breeder Permit

TRANSPARENCY MASTER #2 — Incubation Trouble Shooter

TRANSPARENCY MASTER #3 — Guidelines for Minimizing Disease Loss

INFORMATION SHEET #1

Game and Game Bird Breeders - Necessity of Permit

Sec. 3.23. Before any person shall hold, possess or engage in the raising of game mammals, game birds or migratory game birds protected by this Act, he shall procure a permit from the Department to do so. Any person desiring to possess, propagate, hold in captivity not more than 100 in the aggregate of any species protected by this Act may do so by acquiring either a Class A Noncommercial bird breeders permit or a Class A Noncommercial game breeders permit. Any person desiring to possess, propagate, to hold in captivity, to sell alive, for propagation or hunting purposes, sell dressed for food purposes more than 100 in the aggregate of any species protected by this Act may do so by acquiring a Class B Commercial bird breeders permit or a Class B Commercial game breeders permit.

No person shall breed, raise, sell or offer to sell ferrets without first obtaining from the Department either a Class A noncommercial game breeder permit or a Class B commercial game breeder permit; such permit shall not, however, authorize the use or sale of ferrets for taking any of the wild birds or wild animals protected by this Act.

Except for a Class A noncommercial ferret permit which shall be issued free of charge, the fee for a Class A permit shall be $10. The fee for a Class B permit shall be $20. Both Class A and Class B permits shall expire on March 31 of each year.

Holders of wild game or bird breeder's permits may import game mammals, game birds or migratory game birds into the State of Illinois but may release the same only with the permission of the Director.

Bobwhite quail and male pheasants reared under the provisions of this Act may be released and harvested by hunting during the open season provided by the regulations under Section 2.6 and 2.7 of this Act.

Licensed breeders who hold Class B permits may sell live hand-reared pheasants, bobwhite quail and chukar partridges to organized field trial clubs, or to individuals operating dog training grounds designated by the Department, to be used for field trial purposes and such pheasants, bobwhite quail and chukar partridges may be killed by shooting in connection therewith on areas approved by the Department.

Tags or decals on containers, of a type not removable without breaking or mutilating the tag or decal, shall be used to designate the carcasses of game mammals, game birds or migratory game birds raised in captivity, as provided in this Section, and all game imported legally from any source outside the State of Illinois shall be so designated with irremovable tags or decals. If such tag or decal is not provided for in the State of origin the consignor shall obtain such tags or decals from the Department to identify such carcasses. Upon the application and payment of a fee of 10 cents for such tag or decal, the Department shall furnish permittees with such tags or decals.

Portion of State of Illinois Statutes - Department of Conservation

INFORMATION SHEET #2

Raising Rabbits

Rabbits are produced for meat, fur, and biological research purposes. Most domestic rabbits are raised for meat production. Americans eat 25 to 30 million pounds of domestic rabbit meat each year. This meat production comes from backyard rabbitries as well as large commercial rabbitries. Rabbit production offers the opportunity for a producer to start with a small operation and grow into a large commercial operation, or to maintain a small production unit for family meat production. Rabbit production can also be very educational for the new or young producer, as it includes most all of the production and management areas of other livestock production.

Rabbits best suited in size and conformation for meat and fur production are the medium and large breeds. White skins generally bring the highest prices and may need to be considered when selecting a breed if you have a good market for skins. If you plan to raise rabbits for laboratory purposes, find a market before production begins and raise a breed suited to the laboratories' needs.

Since meat production is the major reason rabbits are produced commercially, the breeds discussed will be those that are suited to meat production.

1. Californian - Mature weight of 8 to 10 1/2 pounds; white body color with dark- or black-colored nose, ears, feet, and tail.
2. Champagne D Argent - Mature weight of 9 to 12 pounds; under fur dark slate-blue, surface fur blue, white, or silver with a liberal sprinkling of long black guard hairs.
3. English Spot - Mature weight of 9 to 12 pounds; white body with black, blue, chocolate, tortoise, lilac, gray, or steel-gray spots; head spots appear on nose, ears, cheeks, and as circles around the eyes; spine spots extend from the base of the ears to the middle of the hindquarters.
4. Flemish Giant - Mature weight of 13 pounds or more; body colors may be black, blue, fawn, light gray, sandy steel-gray, or white.
5. New Zealand - Mature weight of 9 to 12 pounds; body colors may be black, red, or white.

Areas that should be considered in selection of breeding stock are health, vigor, longevity, ability to reproduce, and desirable type and conformation.

When starting in the rabbit business, select young animals in order to become acquainted with the rabbits and their habits before they reach breeding age. Begin production on a small scale and, if you so desire after having gained experience, expand the rabbitry.

A list of rabbit breeders can be obtained from local, state, and national breeders' organizations. Deal directly with reliable breeders who will stand behind the stock they offer. Do not buy stock from sources where the parentage and production practices are not known.

Use the breed standards provided in the *Standard of Perfection* published by the American Rabbit Breeders' Association, for selection of breeding stock. The characteristics and selection procedures for each breed are provided. Experienced rabbit producers may also provide valuable assistance in the selection of breeding stock.

When planning a rabbitry, review literature on the subject, visit several established breeders, and discuss building and equipment needs with the breeders. During the planning process remember to consider local building regulations, climatic conditions, the size of your planned operation, and the amount of money to be invested.

Hutches can be placed outdoors in the shade of trees or buildings. Also, a light superstructure may be used to provide shade. Sunlight in a rabbitry can help maintain sanitary conditions, but rabbits should have a choice between sunlight and shade at all times.

During hot weather additional cooling is generally needed. Overhead sprinklers or foggers can be placed in buildings to help with cooling. If breeding is attempted during very hot weather, additional cooling, such as placing containers of ice in the hutch, or air conditioning, may be needed. Make sure the buildings used are well ventilated and receive the benefit of prevailing breezes.

Individual hutches should be provided for mature rabbits. Hutches should be about two feet high and two feet deep. Make the hutches three feet long for large breeds. Hutches may be made of all wire for use inside buildings or semi-enclosed for outdoor use.

Wire mesh flooring is used in commercial rabbitries, allowing for self-cleaning. Wire mesh is often used in small rabbitries; however, a solid wood floor or a combination wood and wire mesh can be used with regular cleaning. The wire mesh used should have a wire spacing of one-half inch by one inch.

A good nest box should be used to provide seclusion for the doe when she gives birth to her litter as well as protection for the litter. It should be simple to clean and maintain, provide good drainage and ventilation, and be accessible to the young when they are large enough to leave and return to the nest. The nest box should be 15 inches long, 11 inches tall with a 6 inch front lip to keep the young in while they are young but allow them to leave and return as they get older. A bedding of wood shavings and hay should be used in the nest box.

Use feed crocks, troughs, hoppers and hay mangers that are large enough to hold several feedings. Use a type that will prevent waste and contamination of feed.

You can purchase crocks especially designed for rabbit feeding. These crocks are heavy enough so they won't be tipped, and they have lips that prevent the rabbits from scratching out feed. Crocks can be used for feeding pellets or whole grain.

When hay or green feed is included in the ration, hay mangers should be incorporated into the hutches. Space can be saved by having one manger serve two hutches. Hay waste can be reduced by placing troughs under the mangers. These troughs can also be used to feed supplemental grains.

Hoppers save considerable time and labor when they are designed for self-feeding. Use them for feeding pregnant does, does with suckling litters, and rabbits being conditioned for market. Hoppers can be made from cans, wood, or other suitable material.

Rabbits need clean, fresh water at all times. During warm weather, a doe and her litter will drink about one gallon of water per day.

Crocks or large cans are suitable watering devices for small rabbitries. Automatic watering systems provide a steady supply of clean, fresh water. They are used extensively in commercial rabbitries to reduce labor, but they are generally not practical for use in most small rabbitries.

Feed is one of the most important and most expensive components of rabbit production. Feeding must be designed to meet the needs of the herd and the type of production of the rabbitry.

Hay can be fed to supply the bulk, or fiber, required for a balanced rabbit ration. High-quality hay can also provide much of the protein needed by rabbits.

Any type of high-quality legume or grass hay can be fed to rabbits. Fine-stemmed, leafy, well-cured hay can be fed whole. Coarse hay should be chopped into three- to four-inch lengths to reduce waste and make the hay more convenient for feeding.

Most grains including oats, wheat, barley, sorghum grain, and corn can be fed whole or in milled form. To prevent waste, feed flinty varieties of corn in meal form. Since grains are similar in food value, they can substitute for each other without materially altering the nutritive value of the ration.

Soybean, peanut, and linseed meals are rich in protein and can be used as protein supplements to balance rabbit rations. Protein meal should be mixed with whole grains because much of the meal will settle out and be wasted. If whole grains are fed, supply the protein in flake, cake, or pelleted form.

The salt requirement can be supplied by putting small salt blocks or spools in the hutches so the rabbits can feed at will.

Many brands of pelleted feed are available on the market. Pellets require little storage space and are easily fed. Pellets are generally a good method of feeding a small number of rabbits because they reduce the number of feeds that must be purchased. There are two general types of pelleted rabbit feed. All grain pellets are to be fed with hay, while some pellets are a complete feed.

Pelleted rabbit feed should be bite-size. Pellets should be no longer than 3/16 inch in diameter and 1/4 inch long. If pellets are larger, small rabbits will bite off part of a pellet and waste the rest. The ingredients of pelleted feeds will vary. Follow the advice of the manufacturer when pellets are used in the ration.

Fresh green feeds and root crops can be used in the ration when they fit into the management program. These feeds should be used sparingly with rabbits that are unaccustomed to them. Do not use feed that is spoiled or contaminated.

Junior does and bucks, mature dry does, and herd bucks not in service but in good physical condition can be maintained on hay alone if fine-stemmed, leafy, legume hay is fed. If coarse legume hay or grass hay is fed, give each eight-pound animal two ounces of all-grain protein mixture daily. Adjust the amount of concentrate in the ration for rabbits of other weights. Feed herd bucks in service the same amount of concentrate and give them free access to choice quality hay.

Alfalfa pellets may be full-fed to developing junior does and bucks as the only feed from the time they are weaned until they are ready for breeding. Purchase pellets containing 1 percent salt and 99 percent of No. 2 leafy or better grade alfalfa meal (15 percent protein).

To feed a doe properly, it is necessary to know definitely whether she has conceived. Palpating 14 days after breeding is a quick and accurate method of determining pregnancy.

After the mating, maintain the doe in breeding condition on good quality hay. If the doe fails to conceive as determined by palpation 14 days after breeding, breed her again and keep her on a maintenance ration until she is diagnosed as pregnant.

When the doe is diagnosed as pregnant, give her all the concentrates she will eat in addition to good-quality hay. All grain pellets or a grain-protein mixture can be fed with the hay, or a complete pelleted ration and no hay can be fed.

Gradually change over to the new ration. Sudden changes in rations fed during the gestation period may cause some does to go "off feed."

After the doe kindles, feed her in the same manner as during pregnancy. Keep her on the high-concentrate ration until the young are weaned. Provide additional feed as the litter develops.

The gestation period of rabbits is 31 or 32 days. Some litters may be kindled as early as the 29th day or as late as the 35th day, but 98 percent of the normal litters will be kindled between the 30th and 33rd day.

The proper age of bucks and does for the first mating depends on the breed and individual development. Small breeds develop more rapidly and are sexually mature at a younger age than medium and large breeds. Some individual rabbits within a breed will develop more rapidly than others. Generally, the small breeds can be mated when the bucks and does are four to five months old, the medium breeds at five to six months, and the large breeds at nine to twelve months. Mate does when they reach maturity. If mating is delayed too long, breeding difficulties may occur. Does that are maintained in good physical condition should produce litters until they are 2 ½-3 years old.

If rabbits are being raised for show purposes, it may be advisable not to raise more than two or three litters per year. Arrange matings so the offspring will be of proper age and development for show classifications.

For meat and fur production you can work breeding animals throughout the year. With a gestation period of 31 or 32 days and a nursing period of six to eight weeks, a doe can produce four litters in a 12-month period. Does of heavy producing strains can be mated 35 days after kindling if they are in good condition. If a litter is lost at kindling and the doe is in good condition, she can be rebred earlier than called for by the regular schedule.

A doe shows signs of being ready for mating by restlessness and nervousness, by rubbing her chin on feeding and watering equipment, and by attempting to join other rabbits in nearby hutches. It is not necessary to depend on external signs to determine when a doe is to be bred. Set up a definite schedule and follow it, whether the does show signs of being ready for service or not.

Always take the doe to the buck's hutch for service. Mating should occur almost immediately when you place the doe in the buck's hutch. When the mating is completed, return the doe to her own hutch. Make a record of the date of mating and the name or number of the buck and doe. Attempt mating does each day until mating is successful.

Try to maintain one buck for each ten breeding does. Mature, vigorous bucks can be used several times a day for a short period.

An accurate method of determining pregnancy is important in managing the breeding herd. Test mating (placing the doe in the buck's hutch periodically) is not accurate because some does will accept service when pregnant and others will refuse service when not pregnant. Diagnosing pregnancy by the development of the abdominal region and the gain in flesh is not dependable until late in the pregnancy period.

Pregnancy can be quickly and accurately determined by palpating the doe 12 to 14 days after mating. To restrain a doe for palpating, hold the ears and the fold of skin over the shoulders in the right hand; place the left hand between the hind legs, slightly in front of the pelvis; place the thumb on the right side and the fingers on the left side of the abdomen; exert light pressure and move the fingers and thumb gently backward and forward. If the doe is pregnant, you should be able to distinguish the embryos as marble-shaped forms as they slip between the thumb and fingers. Handle the doe gently and use only light pressure on the abdominal cavity.

Does diagnosed as pregnant should be placed on a pregnancy ration. Nonpregnant does should be rebred and kept on a maintenance ration until they are diagnosed as pregnant.

Accurate determination of pregnancy by palpation takes practice. If you are inexperienced, repalpate does diagnosed as nonpregnant a week later. If a mistake has been made in the first palpation, the doe can be put on a pregnancy ration and provided with a nest box at the proper kindling time. With practice, you may develop enough skill to diagnose pregnancy as early as the tenth or eleventh day.

Place a nest box in the hutch 27 days after the doe is mated. A day or two before kindling, the doe will start to pull fur from her body to line the nest, and she usually consumes less feed than the normal amount. Give her small quantities of green feed. This will have a beneficial effect on her digestive system.

Most litters are kindled at night. Kindling complications are rare when the doe is in good condition. After kindling, the doe may be restless. Do not disturb her until she has quieted down.

Sometimes does fail to pull fur to cover their litters, or they kindle their litters on the hutch floor. When this occurs, arrange the bedding materials to make a comfortable nest and pull enough fur from the doe's body to cover the litter. You can often save the young rabbits by warming them, even if they appear lifeless. Keep some extra fur on hand for such cases.

Inspect the litter the day after kindling. Remove any deformed, undersized, or dead young from the nest box. If you are careful and quiet when inspecting the litter, the doe generally will not object. If the doe is nervous and irritable, place some tempting feed in the hutch to distract her attention.

You can transfer baby rabbits from a large litter to a foster mother that has a small litter. For meat and fur production, seven to nine per litter is desirable. Adjusting the number of young to the capacity of the doe will promote more uniform development and finish at weaning. For best results, the young rabbits should not vary more than three to four days in age when they are transferred.

The young rabbits should open their eyes 10 to 14 days after birth. The eyes of baby rabbits occasionally become infected and fail to open normally. If the infection is treated promptly, the young rabbits usually recover without any permanent eye injury. To treat the infection, bathe the inflamed and incrusted eyelids with warm water. When the tissue softens, separate the lids with a slight pressure. If pus is present on succeeding days, treat the eyes with an antibiotic eye ointment or a fresh solution containing two percent argyrol.

Young rabbits start coming out of the nest to eat feed when they are 19 or 20 days old. If the young come out of the nest sooner, they may not be getting enough milk or the nest may be too warm.

The doe usually nurses her young at night or in the early evening and morning hours. If the litter becomes divided, the doe will either nurse the young in the nest or those on the hutch floor. She will not nurse both groups, nor will she pick up the young and return them to the nest.

Leave the young rabbits with the doe until they are six to eight weeks old. By that time, the milk supply will have decreased and the young will be accustomed to eating other feed. Fryer rabbits should be in marketing condition at about eight weeks of age.

Mark each breeding rabbit for your record system. Tattooing is the best marketing method because it is permanent and will not disfigure the ears. Tattooing instruments can be obtained from biological and livestock supply houses. An adjustable box is convenient to restrain rabbits for tattooing (Appendix A). Ear tags and clips are not satisfactory for marking because they tear out and disfigure the ears.

A convenient and simple record system is needed to keep track of breeding, kindling, and weaning operations. Information from the records can be used to cull unproductive animals and to select desirable breeding stock. The essential features of a simple performance card, and a hutch card can usually be obtained from feed mills or firms dealing in rabbitry supplies.

Sanitation in the rabbitry is the best disease control method. Remove manure, soiled bedding, and contaminated feed from the rabbitry daily. Wash the watering and feeding equipment frequently in hot soapy water. Rinse in clear water, drain well, and place in the sun to dry. If sun drying is impractical, rinse the equipment in a water-disinfectant solution, then rinse again in clear water.

Isolate animals suspected of being diseased. Leave suspected animals in isolation for at least two weeks, or until you can determine definitely whether they are dangerous to the health of the herd. Newly acquired rabbits and those returned from shows should be placed in quarantine at least two weeks. Bury or burn dead animals.

Effective treatments are not known for some rabbit diseases. It is usually safer and simpler to destroy a few animals than to risk the spread of disease to the healthy stock. This is especially true of animals that have respiratory infections.

Rabbits are often injured by improper handling. Never lift rabbits by the ears or legs. The proper way to lift and carry a medium or large rabbit is as follows: Grasp the fold of skin over the shoulder with the right hand and support the rabbit by placing the left hand under the rump. If the rabbit scratches or struggles, hold it snugly under the left arm.

Toenails of rabbits confined in hutches do not wear normally. The long toenails often get caught in wire mesh flooring and the rabbits injure themselves trying to get loose. You can prevent this problem by cutting the toenails periodically. Hold the rabbit's foot up to daylight and observe the cone in the toenail. Use sidecutting pliers and cut the toenail below the tip of the cone. When done correctly, this operation will not cause hemorrhaging or injury to the sensitive part of the toenail.

Some producers sell live rabbits direct to brokers. However, many small producers do their own slaughtering, packaging, and marketing.

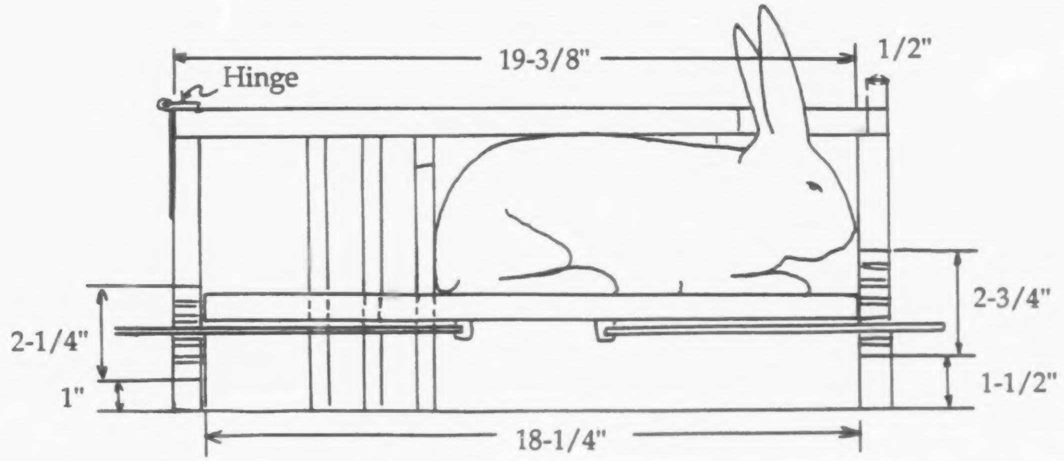
Rabbits raised for meat and fur are usually marketed when they reach fryer weight (four to six pounds). Most medium and large breeds should develop a desired weight and finish by the time they are two months of age.

In some areas there may be a good market for roasters (mature rabbits). Culls from the breeding herd can be fattened for roasters, or it may be profitable to develop young rabbits to heavier weights.

An increasing demand of rabbits for biological purposes offers marketing opportunities to breeders living near hospitals and laboratories.

Appendix A

The spring-type holders tacked to the lower side of a movable floor push the rabbit toward the top of the box. A movable cross partition holds the rabbit toward the front.



INFORMATION SHEET #3

Raising Pheasants

The most common breed of pheasant raised is the Ringneck, and is generally considered to be the most useful, all-purpose pheasant. However, the methods used to raise the Ringneck can be successfully used with other breeds.

Pheasants are protected by state game laws. If you decide to raise them, you must obtain a license from the state to sell pheasant.

Breeding stock should come from a source that is tested and shown to be pullorum free. Choose birds for their size, weight, and feathering, and without visible defects. Select birds that feather rapidly in true plumage color.

In mating, one male is provided for each five or six females. Individual mating pens with only one male are more satisfactory than larger pens. However, some producers use community pens holding about 40 hens and 20 males.

Pheasants should be kept in covered pens on well-drained soil. The moveable pen usually 8 feet wide, 12 feet long, and 6 feet high is the most desirable type. These pens should be moved at least three times during the breeding season to control diseases and parasites. These pens are also suitable for winter holding pens.

If birds are held in a separate pen during the winter, they should be taken from winter holding pens and put in laying pens about four weeks before the mating season, which is usually about the first of March. They should be culled at this time and only the select birds kept for breeders. Cornstalks or brush should be placed in the center of the pens, with nest boxes placed under the covering so the birds can hide if animals such as cats and dogs come near.

Egg production can be increased by the use of artificial lights. Increase light to 14 to 15 hours daily and hold constant throughout the breeding season.

The number of eggs and hatchability obtained will depend largely on the quality of rations fed to the breeders. If pens are moved so that green feed is available, hatching results are likely to be more satisfactory. Any good laying and breeding mash feed with ample grain will give good results.

Some pheasants will lay 50 or more eggs in a season, but the average production is about 35 eggs. Eggs should be gathered each day. However, after the weather gets warm, it is best to gather eggs more often.

Eggs should be stored in a cool place (a temperature of 50 to 60 degrees F is desirable). Incubation should follow soon after the eggs are laid. In no case should they be held more than three weeks.

The incubation period for the pheasant is 23 to 24 days. Follow temperatures that are recommended by manufacturers of incubators for best hatchability.

Some producers of pheasants brood their birds in colony brooder houses. However, where only a few pheasants are grown, brooding cages and battery brooders may be more desirable. Small oil or electric house brooders or infrared brooding lamps are satisfactory for brooding pheasant. A temperature of 95 degrees F should be maintained at the level of the chicks for the first week. The temperature is gradually reduced five degrees each week so that it is about 70 degrees F at the end of six weeks. Artificial heat is seldom required after this period.

Chicks should be removed from the incubator and placed under the brooder as soon as they are dried off. A good poultry-starting mash should be placed before the chicks. The nutritional requirements for young pheasants are similar to those of young turkeys. A turkey-starting mash for the first two months would be more satisfactory than a chicken-starting mash. Baby chick feeders and jar-top waterers may be used. One two-foot feeder and one waterer should be provided for each 25 to 50 chicks.

Lack of sanitation is often the cause of failure in raising pheasant. Clean feeders and waterers must be provided. If birds are brooded on litter, it should be replaced each week. Chicks must be observed carefully for nose and toe picking. Any bird that has been picked should be removed from the pen and kept isolated until the wounds are healed. In severe cases of cannibalism, the birds should be debeaked.

When pheasants are about four weeks old, a game bird grain may be fed in addition to the mash. A grain mixture consisting of wheat, cracked yellow corn, and milo may be used. This system of feeding should be continued until the birds are mature. Oyster shell and grit should be supplied during grain feeding.

Prevention is the best method of controlling disease outbreaks in pheasant. After a disease occurs, it is often difficult to halt before serious damage is done. Some of the most common causes of diseases are unsanitary conditions, improper feeding, and overcrowding. Pheasants are subject to the same diseases as chickens.

Pheasants are generally raised for the purpose of stocking farms reserved for hunting by sportsmen. Pheasants can usually be released from the 10th to 14th week of age. They should not be released until they are fully feathered and are able to care for themselves.

Pheasant is a specialty item and should be processed at about 22 weeks of age and packed in an attractive form. Birds are generally sold individually frozen and vacuum packed.

INFORMATION SHEET #4

Incubation

Natural incubation is good, when all goes well, but some hens leave the nest to scrounge for feed. Some break the eggs or dirty the nest.

A good mechanical incubator, properly handled, guards the eggs around the clock, provides ideal temperatures and humidity, and never puts pressure on the eggs. You can hatch a higher percentage of total eggs with the incubator.

1. Two types of incubators — To put it simply, there are two basic types of incubators, still-air and forced-circulation. Incubators come in all sizes, shapes, and qualities. But there are many makes and models with slight variations. Those little dishpan-shaped incubators, and even the miniature see-through classroom incubators that handle six or eight quail eggs, can do an excellent job.
    a. Still-air incubator — Still-air, or natural-draft, incubators have no mechanical means of circulating air within the machine. They depend completely on the upward rise of heated air for ventilation and heat dissipation. There can be a vast difference in temperature at various levels in a still-air machine. There's only one level in a still-air machine where optimum temperature prevails. The thermometer should be placed near, but not touching, the top half of the hatching eggs.
    b. Forced-circulation incubator — Forced-circulation incubators have a fan that continuously circulates warm air to all areas of the incubator. This makes it possible to have layer upon layer of trays of eggs incubating at all levels. Incubation temperatures at the top and bottom of the eggs is more uniform.
2. Five most important factors — The five most important factors which affect incubation, listed in order of importance, are: temperature, humidity, ventilation or air-exchange, position, and turning of eggs. In "natural incubation" the setting hen instinctively takes care of these factors.
    a. Temperature — All living creatures have an optimum temperature range in which they thrive. When environmental temperature exceeds this range, or falls too low, there's a disruption of normal body functions while the bird or animal tries to adjust to its surroundings. If excessive adjustment is required, death occurs. Temperature has the greatest effect on the developing embryo within the game bird egg. Temperature is the principal factor in game bird hatching, but the developing embryo can stand periods of cooler temperature better than it can stand temperatures that are too high. High temperatures for a short period of time during any phase of incubation will damage the embryos much more than low temperatures. Low temperatures increase hatching time and add problems, but aren't as fatal to the embryo as high temperatures.

The Results of Abnormal Incubation Temperatures

Temperature Abnormality	Result
High temperature throughout the entire incubation period.	A shorter incubation period with a greatly reduced hatch. Chicks with bloody navels.
An abnormally high temperature at any time during incubation.	A large number of dead embryos when the incubation is about 85 percent complete.
High temperature around the 12th day of incubation.	A large number of crooked-toe chicks.
High temperature at hatching time.	Chicks with unabsorbed yolks and unhealed navels. Weak, "mushy" chicks. Delayed hatch.
Low temperature.	A large number of unpipped eggs with fully-formed embryos. Sticky chicks.

b. Relative Humidity — Humidity is an important element in egg storage, incubation and hatching. Eggs lose moisture and the air cell enlarges through evaporation during storage and incubation. This is a natural process. Moisture loss is governed by relative humidity, temperature, air-flow (ventilation rate), altitude (air pressure), and size of the egg. Normally, the smaller the egg, the greater will be the loss of moisture. This can explain why most incubator manufacturers recommend higher humidity for incubating quail than they recommend for pheasants.

The Effects of Abnormal Humidity During Incubation

Correct humidity is vitally important during incubation and hatching of game bird eggs. Improper humidity causes many incubation problems that are blamed on temperature. The effects of abnormal humidity are explained in the following chart.

Humidity Abnormality	Effect
Excess humidity.	An increase in the length of the incubation period.
Excess humidity at hatching time.	A large, soft chick or poult.
Excess humidity with excess temperature at hatching time.	Chicks or poults with unabsorbed yolks and unhealed navels.
Low humidity during incubation or hatching.	A large number of pipped eggs from which chicks fail to emerge.
Low humidity during incubation.	Undersized chicks or poults with poor bone development.

c. Ventilation — Ventilation, or air-exchange within the incubator, is very important during the incubation process. Air-exchange is absolutely necessary to supply oxygen through the porous egg shell, and to remove carbon dioxide and other gases produced by the embryo's digestion of yolk. It can also cool the egg.

Ventilation and air circulation have a great effect on temperature and humidity. There is a close inter-relationship, and ventilation is often used to control temperature or humidity in the incubator. There's no danger of supplying too much oxygen, or removing too much carbon dioxide and other gas by-products. However, excessive ventilation will reduce both incubator humidity and temperature.

Some important considerations in regard to ventilation may be summarized as follows:

1) Ventilation is more important in large than in small incubators.

2) Hatching chicks require increased oxygen, so ventilation is most important at hatching time. Don't reduce humidity at this time.

3) In an incubator room with very high humidity, the humidity in the incubator won't be reduced, regardless of the amount of ventilation applied.

4) At a room temperature below 65 degrees F, ventilating an incubator will reduce both temperature and humidity. Since the developing embryo has greater tolerance to fluctuations in humidity than to changes in temperature, a temporary increase in humidity will have little effect. It's always advisable to maintain the correct temperature.

5) Ventilation in excess of the recommended amount may be applied to reduce temperature or humidity, but should not be increased if both these factors are normal.

662

6) Conditions in the incubator, atmospheric conditions, and altitude can influence the amount of ventilation to apply to an incubator.

7) The appearance of chicks panting, chirping, and scurrying around the hatching tray indicates a shortage of oxygen in the hatching air. Under such conditions chicks must breathe faster to obtain the required amount of oxygen and to eliminate excess carbon dioxide. Oxygen deprivation may decrease hatchability, reduce growth, and prevent development of a normal circulatory system.

8) Insufficient ventilation at hatching time can cause enlargement of blood vessels of the lung. The vessels will take on the dark color associated with cyanosis or oxygen starvation. It can result in death to the embryo or to the chicks.

d. Position and turning of eggs — Early research at Iowa State University shows that in "natural incubation" a chicken hen will "turn" (shift) her eggs an average of 96 times in 24 hours. A pheasant hen shifts the eggs an average of once each hour.

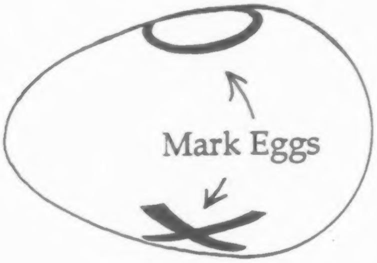
Turning reduces the tendencies of the embryo to stick to the shell membranes. If the eggs remain in the same position too long during the first 16 days of incubation there's a good chance the embryo will adhere to the membrane. Frequent turning can reduce early embryonic mortality, increase hatchability, and increase the probability that the chick is in the correct position at hatching time.

In small incubators the eggs are maintained in a horizontal position during the entire incubation period. In such a situation where eggs must be turned by hand it's smart to turn an odd number of times each day - say three or five times. This way, the eggs aren't in the same position for the longer overnight periods.

An ideal way to insure uniform hand-turning is to mark an "X" on one side and an "O" on the other side. This way you can tell when you've hand-turned all the eggs. Either all the X's or all O's should be visible at the same time. When turning eggs in a still-air machine, move them to a different part of the setting tray to compensate for temperature variations that occur with incubators having no fan circulation.

Many incubators are equipped with automatic egg-turning devices which can be regulated to rotate the eggs at different intervals. Frequent turning during the first 16 days of incubation is most helpful. The greatest benefit from turning occurs during the first week of incubation.

It's very important to avoid jarring the eggs during the first 24 hours of incubation. Jarring and banging at this time can cause damage to the vitelline blood vessels which develop from the blood island. Interruption of the vitelline blood system formation may produce high mortality among the young embryos and result in a decreased hatch of the remaining embryos, owing to rupture of the egg cell membrane.



INFORMATION SHEET #5

Sexing Day-Old Ringnecks

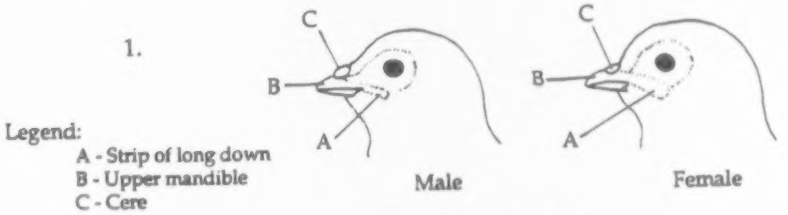
In the Ringneck chick, the shape and extent of the cheek patch, or eye field, is used as the sex indicator. (The variations in color and markings of the down are completely disregarded.) Regnier says in regard to adult birds, "The cheeks of the male are ornamented with scarlet, turgid, papillary tissues which undergoes seasonal changes of form, size and shape of the papillae. Its coloration is due in part to a zoocrylthrine, localized as a cytoplasmic inclusion in the basal portion of the malpighian layer. The cheeks of the female possess neither papillae nor red pigment." In the day-old chick, the cheek patch of both sexes is entirely covered by natal down. This is shorter than that covering the surrounding areas, thus producing a definite outline surrounding the eye field.

The down-covered field of the typical female chick is more nearly round than that of the male and in some instances forms an almost perfect circle. Extending from the nasal opening posteriorly downward along approximately one quarter of the circumference of cheek patch, runs an unbroken, comparatively wide strip of longer down (Figure 1-A). This varies from about one-sixteenth to three thirty-seconds of an inch in width.

In the male, the eye field is rounded at the back of the head, but is definitely angular on the side extending forward toward the bill. This pointed section protrudes far into the "V" formed by the upper mandible (Figure 1-B) and the cere (Figure 1-C), thus greatly reducing the width of that strip of long down so characteristic of the female chick (Figure 1-A).

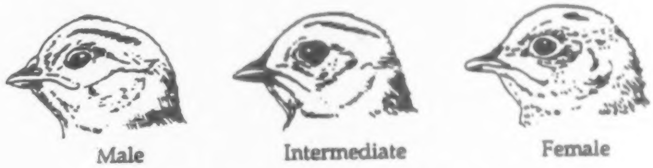
Though not a positive indicator of sex, it may be helpful to know that in profile the forehead and the upper mandible is usually more nearly straight in the case of males than among females. In other words, as a rule, the foreheads of the females rise more abruptly from the beaks than do those of the males (Figures 1, 2, and 3).

1.



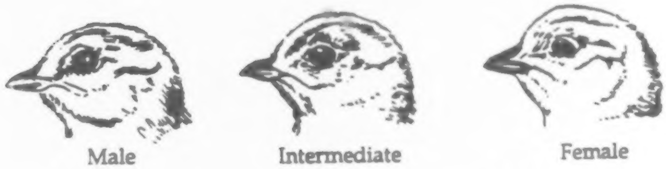
Day Old Pheasant Chicks
Showing Male and Female Characteristics

2.


Male Intermediate Female

Typical Ringneck Pheasant Chicks

3.


Male Intermediate Female

Typical Ringneck Pheasant Chicks

It was discovered in developing the sex-indicating technique that in addition to those individuals exhibiting either typical male or female eye patches, a small percentage of the chicks were of an intermediate type, showing both male and female characteristics. In this group, a portion of the eye field enters the "V" posterior to the upper mandible as in typical males, yet the strip of down immediately below is of sufficient width to be characteristic of females. It has so far been impossible accurately to sex individuals of this type. It is, however, not unlikely that further use of the method and continued experimentation will make possible a reduction in the number of birds which must be classified as intermediate, or perhaps even an elimination of the classification.

Typical specimens of each of the three groups, male, female, and intermediate, are portrayed in Figures 2 and 3.

On the basis of both university and field tests, together with the knowledge and experience gained from investigation, it is believed that, with limited practice, any experienced pheasant propagator, or any interested research worker, can sex newly hatched Ringneck Pheasants with better than 90 percent accuracy just as soon after removal from the incubator as the down on the head has thoroughly dried. Furthermore, the older the birds become, the more pronounced are the sexual characteristics, thus increasing the possible accuracy of sexing among such individuals.

TRANSPARENCY MASTER #1

Sample Application for Wild Game and Bird Breeder Permit

State of Illinois
Department of Conservation

Application Blank - Wild Game and Bird Breeder Permit

(This is not a permit)

Before any person shall hold, possess or engage in the raising of game mammals, game birds, or migratory game birds protected by the Illinois Game Code, he shall procure a permit to do so, as described below. (Please check desired permit)

( ) CLASS A (Non-Commercial) FERRET PERMIT (FREE)
Any person desiring to possess, propagate, hold in captivity not more than 100 ferrets. This permit does not authorize selling of ferrets.

( ) CLASS A (Non-Commercial) $10.00
Any person desiring to possess, propagate, hold in captivity not more than 100 in the aggregate any species noted on the back of this form (excluding ferrets), but not for sale.

( ) CLASS B (Commercial) $20.00
Any person desiring to possess, propagate, hold in captivity, to sell alive for propagation or hunting purposes, sell dressed for food purposes, more than 100 in the aggregate any species noted on the back of this form.

Name of Applicant ____________________

P.O. Box or Street Address ____________________ Telephone Number ____________________

City, State and Zip Code ____________________ County ____________________

1. Date stock will be obtained ____________________
2. Stock will be obtained from: ____________________

Name ____________________ Illinois Permit # ____________________

Address ____________________ Other State Permit # ____________________

____________________ Federal Permit # ____________________

Anyone desiring to become a breeder of game animals or game birds must obtain a breeder permit before purchasing stock, and then the stock can only be obtained from another licensed breeder. **Game taken in the wild is illegal and would not be authorized under this permit. Such game would be subject to confiscation and the holder would be subject to fine.**

Do Not Use This Space

Permit # ____________________

Date Issued ____________________

TRANSPARENCY MASTER #2

Incubation Trouble Shooter

Symptoms	Probable Causes
Hatching too early with bloody navels	Temperature too high
Draggy hatch; some chicks early, but slow in finishing	Temperature too high
Delayed hatch; eggs not pipping	Temperature too low
Short down on chicks	High temperature; low humidity
Mushy chicks dead on trays; bad odor	Navel infection, and remains in incubator
Chicks too small	Low humidity; high temperature
Sticky chicks; shell sticking to chicks	Eggs dried down too much; low humidity at hatching time
Sticky chicks; chicks smeared with egg contents	Low average temperature; humidity may be too high
Crippled chicks, missing eye, cross beak, extra leg, etc.	Mostly chance; heredity in some cases; also temperature
Rough navels	High temperature; low humidity

TRANSPARENCY MASTER #3

Guidelines for Minimizing Disease Loss

Most death losses in game birds are due to disease, cannibalism, and "starve-out." Though not applicable to every game bird disease, the following factors are essential for an effective preventive type disease program.

1. Start with disease-free eggs or chicks.
2. Clean, well-drained pens.
3. It's advisable to raise quail and chukars on wire.
4. Have good nutrition program.
5. Plentiful supply of potable water.
6. Sanitation: feeders, waterers, shoes, clothing, etc.
7. Keep areas around feeders and waterers dry and clean.
8. Prevent "stress" as much as possible.
9. Control free flying birds, rodents, and predators.
10. Tender loving care.
11. Vaccinate when applicable.
12. Isolate sick birds.
13. Proper dead bird disposal.
14. Laboratory diagnosis.
15. Watch for feather picking and take corrective measures.
16. Avoid "management mistakes."

STUDENT ACTIVITIES

STUDENT WORKSHEET #1 — Rabbits

STUDENT WORKSHEET #2 — Pheasants

For additional activities, teachers may refer to the "Suggested Teaching Activities and Procedures" section in the Instructor's Guide.

STUDENT WORKSHEET #1

Rabbits

1. Match the following:

_________ white body color with dark- or black-colored nose, ears, feet, and tail

_________ white body with black, blue, chocolate, tortoise, lilac, gray, or steel-gray spots

_________ under fur dark slate-blue, surface fur blue, white, or silver

_________ body colors may be black, red, or white

_________ body colors may be black, blue, fawn, light gray, sandy steel-gray, or white

a. English Spot

b. Flemish Giant

c. New Zealand

d. Californian

e. Champagne D'Argent

2. Place a check beside the selection practices that should not be done or looked for in selecting rabbit breeding stock.

_______ a. healthy

_______ b. ability to reproduce

_______ c. start with older experienced rabbits

_______ d. start with a large number of rabbits to gain experience

_______ e. buy the least expensive stock available regardless of source

_______ f. use breed standards published in the *Standard of Perfection* for selection of breeding stock

3. A rabbit producer wants to raise medium-sized rabbits. What sizes and types of hutches does he need?

4. A rabbit producer has high-quality grass hay that he has produced. He also has very little room for storage of additional feeds, which must be purchased. What would be the best types of feed for him to use?

5. List five management procedures that should be considered in producing a medium-sized breed of rabbits.

Multiple Choice (6, 7, and 8):

6. Place a nest box in the hutch __________ days after the doe was mated.
   a. 20
   b. 27
   c. 33
   d. 40

7. Most litters are kindled ____________.
   a. at night
   b. during the morning
   c. in the afternoon

8. If baby rabbits' eyes are infected and do not open properly you should _______________.
   a. destroy the rabbits
   b. leave the rabbits alone
   c. bathe the eyes with warm water
   d. give the rabbits an injection of an antibiotic

9. List steps that should be taken to keep proper records for a rabbitry.

10. Check the rabbit production procedures that are needed for proper disease control.

_______ a. remove manure daily

_______ b. wash watering and feeding equipment frequently

_______ c. leave animals returned from shows in quarantine for two months

_______ d. quarantine all newly purchased animals

_______ e. wash rabbits weekly

11. List four ways in which rabbits can be marketed.

671

STUDENT WORKSHEET #1 — Key

Rabbits

1. Match the following:

__d__ white body color with dark- or black-colored nose, ears, feet, and tail — a. English Spot

__a__ white body with black, blue, chocolate, tortoise, lilac, gray, or steel-gray spots — b. Flemish Giant

__e__ under fur dark slate-blue, surface fur blue, white, or silver — c. New Zealand

__c__ body colors may be black, red, or white — d. Californian

__b__ body colors may be black, blue, fawn, light gray, sandy steel-gray, or white — e. Champagne D'Argent

2. Place a check beside the selection practices that should not be done or looked for in selecting rabbit breeding stock.

____ a. healthy

____ b. ability to reproduce

__✓__ c. start with older experienced rabbits

__✓__ d. start with a large number of rabbits to gain experience

__✓__ e. buy the least expensive stock available regardless of source

____ f. use breed standards published in the *Standard of Perfection* for selection of breeding stock

3. A rabbit producer wants to raise medium-sized rabbits. What sizes and types of hutches does he need? *Hutch Size — feet high, 2 feet deep, 4 feet long. Hutch floor — wire mesh flooring with a spacing of ½ inch by 1 inch.*

4. A rabbit producer has high-quality grass hay that he has produced. He also has very little room for storage of additional feeds, which must be purchased. What would be the best types of feed for him to use? *Use the high-quality grass hay that he has. Purchase all grain pellets to feed with the hay.*

5. List five management procedures that should be considered in producing a medium sized breed of rabbits.

- *Use mature (5 to 6 month old or older) breeding stock.*
- *Mate does when they reach maturity.*
- *Does can be mated 35 days after kindling.*
- *Does should provide a nursing period of 6 to 8 weeks for young rabbits.*
- *Set up a breeding schedule and follow it even if does show no signs of being ready for service.*
- *Maintain 1 buck for each 10 does.*
- *Palpate does 12 to 14 days after mating.*
- *Does determined pregnant by palpation should be placed on pregnancy ration.*
- *Does determined not pregnant by palpation should be rebred.*

Multiple Choice (6, 7, and 8):

6. Place a nest box in the hutch __________ days after the doe was mated.
   a. 20
   [✓ b.] 27
   c. 33
   d. 40

7. Most litters are kindled ____________.
   [✓ a.] at night
   b. during the morning
   c. in the afternoon

8. If baby rabbits' eyes are infected and do not open properly you should ______________.
   a. destroy the rabbits
   b. leave the rabbits alone
   c. bathe the eyes with warm water
   [✓ d.] give the rabbits an injection of an antibiotic

9. List steps that should be taken to keep proper records for a rabbitry.

   - *Tattoo all rabbits' ears for permanent identification.*
   - *Keep records of breeding, kindling, and weaning operations.*
   - *Use records to cull unproductive animals.*
   - *Use pedigree, record of performance, and hutch cards to keep records.*

10. Check the rabbit production procedures that are needed for proper disease control.

____✓____ a. remove manure daily

____✓____ b. wash watering and feeding equipment frequently

_________ c. leave animals returned from shows in quarantine for two months

____✓____ d. quarantine all newly purchased animals

_________ e. wash rabbits weekly

11. List four ways in which rabbits can be marketed.

    - *Sell live rabbits direct to brokers.*
    - *Sell slaughtered rabbits.*
    - *Sell cull breeding stock as roasters.*
    - *Develop young rabbits to heavier weights for roasters.*
    - *Sell for biological purposes.*

STUDENT WORKSHEET #2

Pheasants

Multiple Choice:

1. The most common breed of pheasant raised is the __________ .

   a. Chinese
   b. Mongolian
   c. Ringneck
   d. Lady Amhersts
   e. Blackneck

2. In mating, one male is provided for each __________ females.

   a. two
   b. five
   c. nine
   d. twelve
   e. twenty

3. Nests should be placed __________ .

   a. under covering in the center of the pen
   b. under covering at one end of the pen
   c. under covering along the sides of the pen
   d. in the open at one end of the pen
   e. all of the above are acceptable

4. To increase egg production, light should be provided __________ hours per day during the breeding season.

   a. eight
   b. ten
   c. fourteen
   d. eighteen
   e. twenty-four

5. Newly hatched pheasants should be brooded at a constant temperature of ________ degrees F for the first week.

   a. 70
   b. 80
   c. 85
   d. 95
   e. 105

STUDENT WORKSHEET #2 — Key

Pheasants

Multiple Choice:

1. The most common breed of pheasant raised is the __________ .

a. Chinese
b. Mongolian
[✓ c.] Ringneck
d. Lady Amhersts
e. Blackneck

2. In mating, one male is provided for each __________ females.

a. two
[✓ b.] five
c. nine
d. twelve
e. twenty

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d. in the open at one end of the pen
e. all of the above are acceptable

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b. ten
[✓ c.] fourteen
d. eighteen
e. twenty-four

5. Newly hatched pheasants should be brooded at a constant temperature of ________ degrees F for the first week.

a. 70
b. 80
c. 85
[✓ d.] 95
e. 105

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Maintaining Wildlife Habitat

RELATED PROBLEM AREAS:

1. Understanding the Relationship Between Agriculture and the Environment (Central Core Cluster)
2. Understanding Animal Anatomy and Physiology (Agriculture Business and Management Cluster)
3. Feeding Game Birds and Animals
4. Controlling Wildlife Pests
5. Raising Game Birds and Animals
6. Managing Game Preserves

PREREQUISITE PROBLEM AREA(S):

1. Conserving Wildlife Resources
2. Classifying Game Birds and Animals

LEVEL: Preparatory

OCCUPATIONAL TASKS ADDRESSED:

Duty A: Managing the Recreational Facility

1. Determine land-use capability
2. Assist in development of resource conservation plans
3. Interpret maps, charts, and aerial photographs

Duty D: Facility Flora and Fauna

1. Identify wildlife species within a selected area
2. Identify endangered or exotic species of plant and animal life in a selected area
3. Identify plant communities and dominant species within a selected area
4. Identify native plant species within a selected area

Duty F: Using Tools, Materials, and Equipment

1. Use hand tools
2. Perform preventative maintenance on equipment

Duty G: Assembling, Servicing, and Maintaining Equipment and Facilities

1. Follow a facility and grounds maintenance schedule
2. Report facility and grounds maintenance needs
3. Inspect structures and conveniences needing maintenance

STATE GOALS FOR LEARNING

In planning the instruction for this problem area, teachers can promote the development of several student learning objectives which are related to the State Goals for Learning in Biological and Physical Sciences and Social Sciences. These objectives are listed on the Learning Assessment Plan forms included on the following page(s). Those learning objectives marked with an asterisk (*) are taken from the sample lists provided by the Illinois State Board of Education.

Illinois Agricultural Core Curriculum
Agricultural Education 124 Mumford Hall 1301 W. Gregory Drive University of Illinois Urbana, IL 61801

Director: Dale A. Law, Ed.D.
Principal Investigator: Jerry D. Pepple, Ed.D.
Research Assistant: Robert E. Petrea

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ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

Submission Date ____________
☐ Original submission ☐ Revision
Page ____ of ____

(Affix label or complete district information.)

COUNTY	DISTRICT	ESC

District Name

City

I. LEARNING AREA *(check one)*

☐ Language Arts ☐ Fine Arts
☐ Mathematics ☒ Social Sciences
☐ Sciences ☐ Physical Development/Health

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will be able to apply the skills and knowledge gained in the social sciences to decision making in life situations.

Contact Person: ____________
Title: ____________
Phone: (   )

By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:

III. LEARNING OBJECTIVES	IV. ASSESSMENT A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	V. EXPECTATIONS Percent of Students Expected to Achieve Objective
*1. Understand the knowledge and skills required for success in selected fields of work.					
*2. Recognize that competence in a field of work entails the development of a wide range of skills.					
3. Plan and create an artificial nesting area to meet the requirements of a particular wildlife species.					
					679
678					

ISBE 41-78 (1/88)

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

Submission Date ____________
☐ **Original submission** ☐ **Revision**
Page ____ of ____

I. LEARNING AREA *(check one)*
☐ Language Arts
☐ Mathematics
☒ Sciences
☐ Fine Arts
☐ Social Sciences
☐ Physical Development/Health

(Affix label or complete district information.)
COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐
District Name
City

II. STATE GOAL FOR LEARNING
As a result of their schooling, students will have a working knowledge of the concepts and basic vocabulary of biological, physical, and environmental sciences and their application to life and work in contemporary technological society.

Contact Person: ____________
Title: ____________
Phone: (   )

III. LEARNING OBJECTIVES

By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:

III. LEARNING OBJECTIVES	IV. ASSESSMENT A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	V. EXPECTATIONS Percent of Students Expected to Achieve Objective
*1. Understand the interactions among populations of plants, herbivores, and carnivores.					
*2. Recognize that the populations of plants and animals change as the environment changes.					
3. Define terms integral to maintaining wildlife habitats.					
4. List and describe the basic requirements for a potential wildlife habitat.					
5. Identify the characteristics of selected species of wildlife.					
680					681

ISBE 41-78 (1/88)

Illinois Agricultural Core Curriculum Rev.

Maintaining Wildlife Habitats

Agricultural Resources
Fish and Wildlife Management

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

Submission Date ____________
☐ Original submission ☐ Revision
Page ____ of ____

I. LEARNING AREA *(check one)*
☐ Language Arts ☐ Fine Arts
☐ Mathematics ☐ Social Sciences
☒ Sciences ☐ Physical Development/Health

(Affix label or complete district information.)
COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐
District Name
City

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will have a working knowledge of the social implications of technical development.

Contact Person: ____________
Title: ____________
Phone: (   )

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Identify materials that are replacing natural resources.					
*2. Predict the consequences of technological change.					
3. Explain the significance of various agricultural and urban practices that maintain and create wildlife habitat.					
4. Plan and create an artificial nesting area to meet the requirements of a particular wildlife species.					
682					683

Maintaining Wildlife Habitat

ISBE 41-78 (1/88)

Submission Date ____________
☐ **Original submission** ☐ **Revision**
Page ____ of ____

I. LEARNING AREA *(check one)*
☐ Language Arts
☐ Mathematics
☒ Sciences
☐ Fine Arts
☐ Social Sciences
☐ Physical Development/Health

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

(Affix label or complete district information.)
COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐
District Name
City

Contact Person: ____________
Title: ____________
Phone: ( )

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will have a working knowledge of the principles of scientific research and their application in simple research projects.

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Demonstrate the ability to draw conclusions from collected data.					
2. Plan and create an artificial nesting area to meet the requirements of a particular wildlife species.					

684

685

ISBE 41-78 (1/88)

Illinois Agricultural Core Curriculum Rev.

Maintaining Wildlife Habitat

Agricultural Resources
Fish and Wildlife Management

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Maintaining Wildlife Habitat

STUDENT LEARNING OBJECTIVES

Upon completion of their study of this problem area, students will be able to:

1. Define terms integral to maintaining wildlife habitats.
2. List and describe the basic requirements for a potential wildlife habitat.
3. Identify the characteristic habitat of selected species of wildlife.
4. Explain the significance of various agricultural and urban practices that maintain and create wildlife habitat.
5. Plan and create an artificial nesting area to meet the requirements of a particular wildlife species.

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Maintaining Wildlife Habitat

PROBLEMS AND QUESTIONS FOR STUDY **INSTRUCTOR'S NOTES AND REFERENCES**

1. What is a habitat?
2. What are the requirements that need to be contained in a habitat?
3. Why should one be concerned about the habitat of game wildlife? Non-game wildlife?
4. What is a niche?
5. What is edge?
6. How can one use the edge effect to increase wildlife habitat?
7. What is carrying capacity?
8. How can carrying capacity be increased?
9. What are factors which affect carrying capacity?
10. What are specific agricultural practices that benefit wildlife?
11. How can one improve existing habitat?
12. What sites within urban areas might be useful to provide habitats?
13. What are the specific habitats within a wooded lot with many different levels of vegetation?
14. What are characteristics of animals that use the various levels of habitat?
15. Why is a park with many tall trees and short clipped grass not useful to many species of wildlife?
16. What are the specific concerns that one should consider when viewing a habitat?

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Maintaining Wildlife Habitat

SUGGESTED TEACHING ACTIVITIES AND PROCEDURES

1. Use resource personnel from the Soil Conservation Service, Illinois Department of Conservation (Divisions of Wildlife Resources and of Forest Resources), Illinois Natural History Survey Wildlife Specialists and Conservation Police, U.S. Department of Interior (Fish and Wildlife Service), Cooperative Extension personnel, and local landowners with Illinois Acres for Wildlife for additional specific information.

2. Obtain copies of publications such as "Benefits of Wildlife" (8981-A) and "History of Wildlife Management" (8982-A) for use by students in discussions about the value of game and non-game wildlife to the general public.

3. Use the referenced texts and publications for additional information on maintaining wildlife habitats.

4. Ask students that hunt or trap to identify the characteristics of the habitats for specific species of wildlife and the interaction of the various levels of vegetative growth on the abundance of wildlife.

5. Conduct field trips to students' hunting or trapping areas for firsthand observation of the requirements needed for wildlife habitats.

6. Use Student Worksheet #1 in conjunction with field trips to various locations for practical experience in taking field notes.

7. Have students select a locally common wildlife species for independent study. Use Student Worksheet #1 for recording observations concerning the species and its habitat.

8. Use Student Worksheets #2 and #3 as possible class or individual projects in providing additional nesting areas for wildlife. These activities can be a starting point for practical experience in considering the other relevant habitat factors of food, water, space, and their arrangement.

9. Lead students in a discussion of other local species for which nesting areas could be constructed. The publication "Wood Projects for Illinois Wildlife" provides nesting area plans for specific species. "Wildlife Management Techniques" is a good reference text for teacher use.

10. Lead students in a discussion of the merits of including wildlife habitats in current or potential SOE or SAE projects. Point out possible FFA activities that can include wildlife.

11. Coordinate a field trip with an employee of the Illinois Department of Conservation to view areas set aside for wildlife.

12. Use the potential urban sites of Transparency Master #6 as local areas to use Student Worksheet #1 for recording field observations. Have students compare the observations with the requirements (Transparency Master #1) of habitats. A possible class project could be to plan improvements (Transparency Master #4) to a selected site, based on research of the requirements of habitat characteristics (Transparency Master #3) for a particular species.

13. Consult the problem area *Conserving Wildlife Resources* for information on rabbit, squirrel, pheasants, quail, deer, and mourning dove.

14. Consult with your local Department of Conservation Office about the Illinois Acres for Wildlife, Urban Acres for Wildlife, and Roadsides for Wildlife programs. Any of these programs might be developed into a class activity by combining the students' classroom study of the needs of a particular species and a joint field effort between the class and an individual landowner or sympathetic township official. The habitat requirements, carrying capacity, and

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Maintaining Wildlife Habitat

SUGGESTED TEACHING ACTIVITIES AND PROCEDURES (con't.)

habitat characteristics can all be addressed in the classroom along with suggestions for maximum diversity. Once potential sites are located, students can practice taking field notes, and these notes, along with photographs, can be used to determine the most beneficial location.

15. Contact the Division of Forest Resources of the Illinois Department of Conservation (IDOC) for information on conservation planning stock and prices that might be used in conjunction with other habitat maintenance efforts.

16. Contact the State of Illinois, Division of Forestry nurseries or the District Forester for your area concerning planting stock for windbreaks. These plantings may add to a habitat planning exercise.

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Fish and Wildlife Management

PROBLEM AREA: Maintaining Wildlife Habitat

REFERENCES

*1. *Agricultural Resources Technical Information (#114B); Benefits of Wildlife (8981-A); History of Wildlife Management (8982-A).* Instructional Materials Service, Texas A&M University, P.O. Box 2588, College Station, TX 77843.

2. *Wildlife Conservation and Management Curriculum Guide for Vocational Agriculture/ Agribusiness (#1853).* (1984). Louisiana Department of Education, Office of Vocational Education, Box 94064, Baton Rouge, LA 70804-9064.

*3. *Wildlife Management Techniques.* Giles, Robert H., ed. (1980). The Wildlife Society, Inc., Suite S176, 3900 Wisconsin Avenue N.W., Washington, DC 20016.

4. *Michigan Agriscience and Natural Resources Education Core Curriculum: Natural Resources and Michigan Agriculture.* (1989). Michigan State Administrative Board, Vocational Technical Education Service, Michigan Department of Education, Box 30009, Lansing, MI 48909. (517) 335-0378.

*5. *A Guide to Urban Wildlife Management.* Leedy, D. L., Adams, L. W. (1984). The Natural Institute for Urban Wildlife, 10921 Trotting Ridge Way, Columbia, MD 21044.

6. *Practical Wildlife Management.* Burger, G. V. (1973). Winchester Press, 460 Park Avenue, New York, NY 10022.

7. *Introduction to Wildlife Management.* Shaw, J. H. (1985). McGraw-Hill, Publication Company, Printceton Road, Hightstown, NJ 08520. (609) 426-5254.

8. *Wildlife Management.* Giles, R. H., Jr. (1978). W. H. Freeman and Company, 4419 West 1980 S, Salt Lake City, UT 84104. (801) 973-4660.

*9. *Illinois Acres for Wildlife; Roadsides for Wildlife; Stream Bank Erosion Destroys Farming and Fishing* (pamphlets). Illinois Department of Conservation Local District Office.

10. *Wood Projects for Illinois Wildlife.* Illinois Department of Conservation, Division of Natural Heritage, 600 N. Grand Avenue, West Springfield, IL 62706. (217) 785-8774.

*Indicates highly recommended reference

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTIONAL RESOURCES

These resources are intended for use by teachers in planning and teaching the materials for this problem area and may be adapted to fit the teaching method(s) used.

INFORMATION SHEET #1 — Terms to be Defined

TRANSPARENCY MASTER #1 — Habitat Requirements (with discussion guide)

TRANSPARENCY MASTER #2 — Carrying Capacity (with discussion guide)

TRANSPARENCY MASTER #3 — Habitat Characteristics (with discussion guide)

TRANSPARENCY MASTER #4 — Projects to Improve Habitats (with discussion guide)

TRANSPARENCY MASTER #5 — Agricultural Practices that Positively Affect Wildlife (with discussion guide)

TRANSPARENCY MASTER #6 — Potential Urban Wildlife Sites (with discussion guide)

TRANSPARENCY MASTER #7 — Habitat Diversity (with discussion guide)

TRANSPARENCY MASTER #8 — Urban Habitat (with discussion guide)

INFORMATION SHEET #1

Terms to be Defined

Habitat — area in which a biological population occurs and provides the necessary requirements.

Diversity — a characteristic of a habitat that provides for a number of species.

Succession — in reference to habitat, the relative age of the current community of plants and animals. The past community has been gradually replaced by the current and the current will be gradually replaced by the next.

Quality and Quantity — in reference to habitat, the amount and value of the basic requirements that determines the kinds and numbers of wildlife that an area can support.

Niche — unique ecological role that allows a particular species to successfully compete for the basic requirements.

Cover — physical and biological arrangement of features that provide shelter from weather or concealment from predators. Cover can be divided into canopy (large trees), understory (small trees), shrubs (brush), and ground.

Edge — boundary area where one kind of land use ends and another type of land use begins. The edge frequently can support larger and more varied wildlife populations than the areas bounded. An example would be a mature woods, bounded by small tress, bounded by native and planted shrubs and sprouts, bounded by unmowed grass, next to a mowed hayfield.

Carrying Capacity — number of each species of wildlife a habitat can support on an annual basis without damage to the habitat or the wildlife.

Population — group of organisms, normally of the same species, that occupy a prescribed area during a particular time period.

TRANSPARENCY MASTER #1

Habitat Requirements

Food

Water

Cover (shelter)

Living space (range)

Additional: That the requirements be located in the proper arrangement

TRANSPARENCY MASTER #2

Carrying Capacity

Ways to increase:

1. Improve existing habitat
2. Create new habitat

Affected by:

1. Succession stage
2. Climate
3. Weather
4. Human modification
5. The basic requirement least available

TRANSPARENCY MASTER #3

Habitat Characteristics

Food Production

Cover

Amount of edge

Species of concern

Condition of individual animals

Observed rate of increase

Species diversity

Natural communities present

TRANSPARENCY MASTER #4

Projects to Improve Habitats

1. Living brush piles
2. Apple tree planting
3. Brush shelters
4. Food and cover species plantings
5. Projects to improve water availability
6. Den and cavity tree retention
7. Providing nest structures
    a. for mammals
    b. for birds
8. Feeding stations
9. Small and odd area management
10. Creating and maintaining woodlot openings

TRANSPARENCY MASTER #5

Agricultural Practices that Positively Affect Wildlife

1. Erosion control
2. Small and odd area management
3. Maintenance of edges
4. Grasslands
5. Strip cropping
6. Ponds
7. Planting food species
8. Marsh maintenance

TRANSPARENCY MASTER #6

Potential Urban Wildlife Sites

Cemeteries

Parks

Wooded sites

Debris piles

Fence rows

Single family residences

Parkways

Golf courses

Lakes, reservoirs

Street and highway rights-of-way

Railroad rights-of-way

Parking lot borders

Stream banks

Vacant buildings

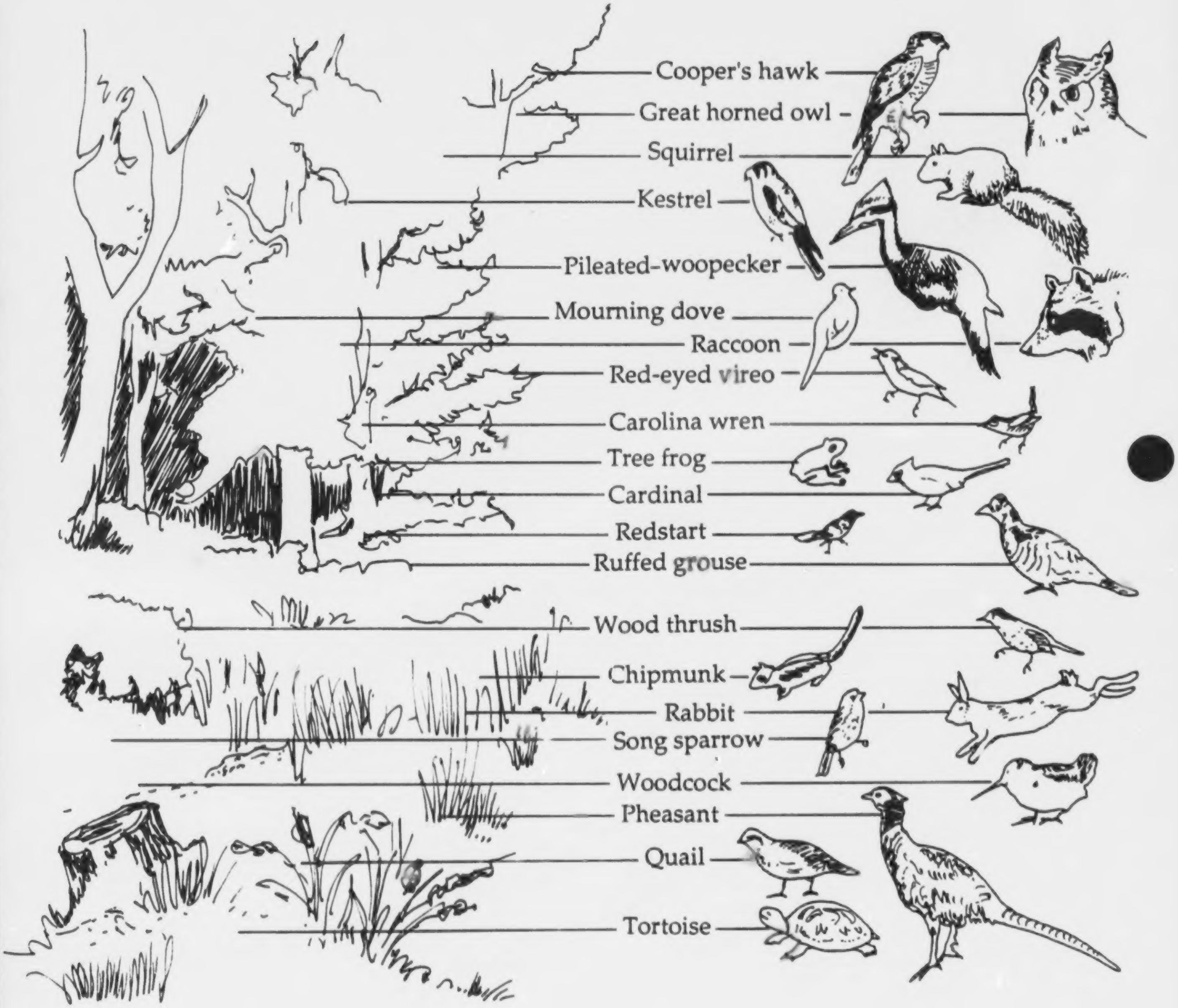
Rooftops

Overhangs

Outside decorations

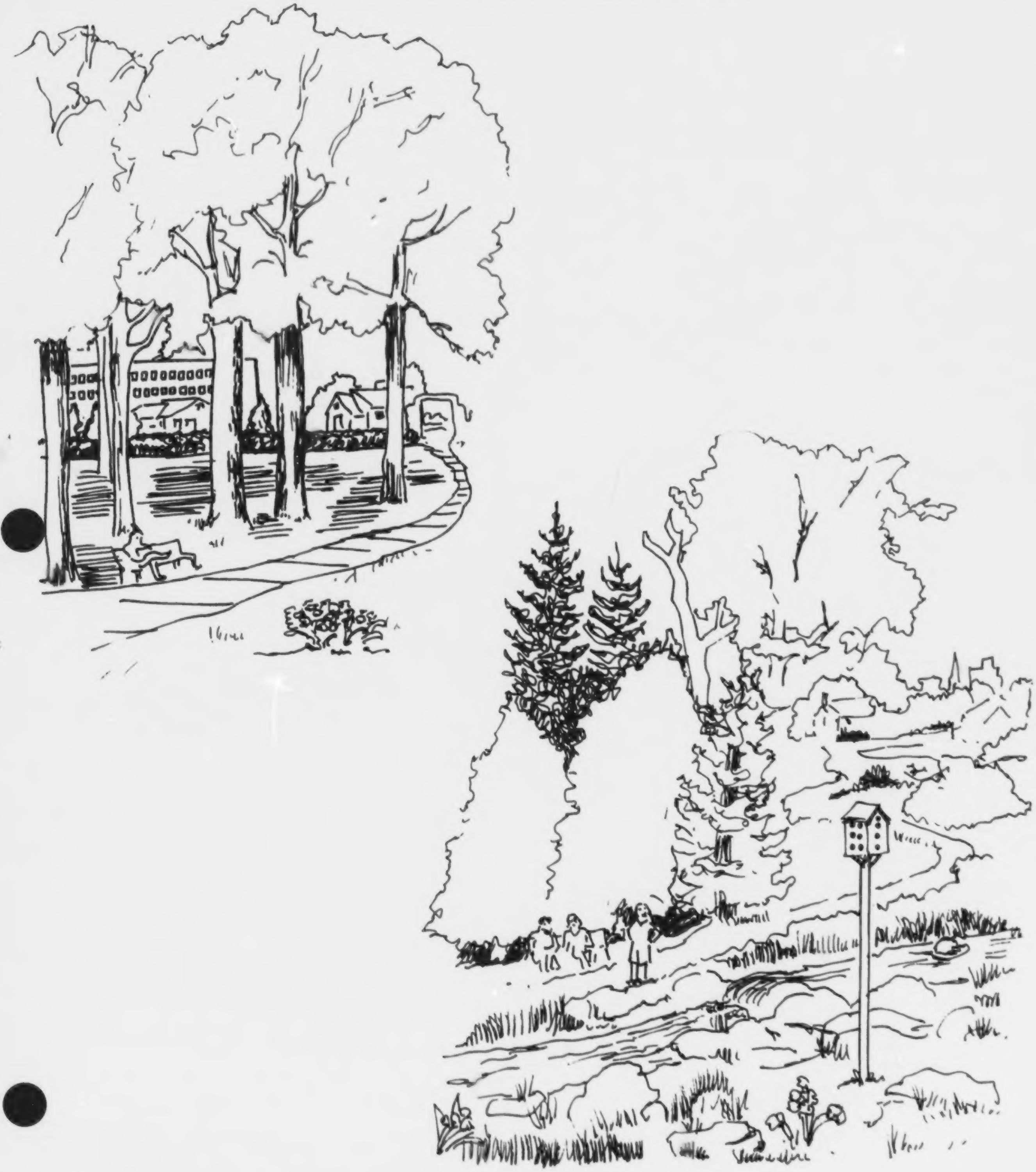
TRANSPARENCY MASTER #7

Habitat Diversity


Cooper's hawk
Great horned owl
Squirrel
Kestrel
Pileated-woopecker
Mourning dove
Raccoon
Red-eyed vireo
Carolina wren
Tree frog
Cardinal
Redstart
Ruffed grouse
Wood thrush
Chipmunk
Rabbit
Song sparrow
Woodcock
Pheasant
Quail
Tortoise

TRANSPARENCY MASTER #8

Urban Habitat



TRANSPARENCY MASTER DISCUSSION GUIDE

Transparency Master #1

A. Lead students in a discussion of each of the requirements needed for a habitat. Have students give examples of each and what happens when one or more than one is absent.

B. Lead students in a discussion of why the *arrangement* of the other requirements is important. Give an example of an instance in which all four requirements are present but in the wrong arrangement, as when the water is located too far from the other three allowing no protection from predators.

Transparency Master #2

A. Refer to the definition of carrying capacity in Information Sheet #1.

B. Use examples from Transparency Master #4 of ways to improve carrying capacity.

C. Use examples such as Student Worksheets #2 and #3 as ways to create additional nesting areas (cover) where the other habitat requirements are.

D. Discuss each of the elements that affect carrying capacity.

Succession — Most wildlife prefer young succession as opposed to mature, though many species use dead or dying trees for nests.

Climate and weather — These factors affect the presence of species in a particular area. Compare the effects on species of cold vs. moderate temperatures and wet vs. dry weather.

Human modification — Refer to Transparency Masters #4 and #5 for positive effects. Ask students to give examples of negative effects, such as indiscriminate cutting of trees for sale, clearing away all dead trees, over-pasturing and over-mowing, etc.

Basic requirement least available — This requirement will be the limiting factor in the carrying capacity. Ask students to give examples of local areas that have most or all requirements but lack wildlife.

Transparency Master #3

A. Lead students through each of the characteristics and how each would affect the habitat.

B. Refer to the terms to be defined in Information Sheet #1, and relate quality and quantity to each of the characteristics.

C. Habitat characteristics include:

1. Food production — Quality and quantity of food available.
2. Cover — Shelter for individual species.
3. Amount of edge — Refer to terms to be defined.
4. Species of concern — Needs of and methods of providing for the desired species determined by its characteristics.
5. Condition of individual animals — Reflects the overall condition of the community.
6. Observed rate of increase — Indicator of potential future, related to condition of individual animals.
7. Species diversity — The more species present, the better the quantity and quality of the basic requirements present. Diversity is related to the number of natural communities present (i.e. the more canopy, understory, and shrubs present, the more variety of species that can be provided for, etc.).
8. Natural communities present — For any particular population to be successful, the basic requirements must be met for that population. Other wildlife with similar requirements will likely be present and each variation in requirements that can be met will allow for even more variety in populations. The interrelationships of predator-prey, herbivore-plant, insectivore-insect, etc., make up the natural communities.

Transparency Master #4

A. Ask students to identify how each of these practices improves habitats.

B. Ask students to identify specific species that benefit from each practice.

C. Example: Living brush piles — A technique of cutting small trees and large shrubs. By cutting through the trunk but leaving approximately one-half of the bark attached, the tree or shrub may be felled to provide close-to-ground shelter in areas with little shelter, but it will continue to live for a length of time, providing shelter longer than it would, had all the bark been removed.

Transparency Master #5

Lead students in a discussion of not only the benefits to wildlife of each of these practices, but also related concerns of natural resource management and reduced use of fuel, pesticides, and insecticides.

Transparency Master #6

A. Lead students in a discussion of how each of these urban sites might provide habitats for wildlife.

B. Use the photography portion of Student Worksheet #1 to collect pictures for use in the classroom.

Transparency Master #7

A. A diversity of habitat will result in a diversity of wildlife.

B. It is desirable to have a mixture of deciduous and evergreen species.

C. In addition to the benefits in item B, different levels of vegetation, from top canopy to ground, are desirable.

D. Dead limbs, tree snags, and fallen trees add to diversity.

Transparency Master #8

A. Ask students to identify the basic requirements met by each picture.

B. Ask students to list reasons why B will provide for more wildlife than A.

702

STUDENT ACTIVITIES

STUDENT WORKSHEET #1 — Taking Field Notes

STUDENT WORKSHEET #2 — Northern Flicker Nest

STUDENT WORKSHEET #3 — Prairie Deer Mouse and White-Footed Mouse Nest

For additional activities, teachers may refer to the "Suggested Teaching Activities and Procedures" section in the Instructor's Guide.

STUDENT WORKSHEET #1

Taking Field Notes

Field notes are records of observations made while working in a wildlife habitat that can be filed and retrieved for later study and use. The major problem with taking notes of wildlife observations is deciding which observations are worthy of record. The advantage of notes is that they eliminate our total reliance on memory for the details of a particular event. The more detail contained in a record, the more useful that record will be. Items to consider for inclusion are rare events, distances, predation, location of marks on animals, plant types, weather conditions, dead and diseased animals, accidents, and nesting structures. While any consistent method is useful, 3"x5" lined index cards are preferable. Use this example as a guide to the information to include on your card.

Observation # Classification
Date Time Location
Cover type
Weather Temperature
Observer
Observation:

Use the following list of classifications. You'll notice that not all classifications are observation related.

Field Note File Classification

Bats
Bear
Bibliography — Wildlife
Birds — General

Chicken — Prairie
Conservation — Wildlife
Control — Wildlife
Coyote

Damage — Wildlife
Disease — Wildlife
Dogs
Dove
Deer
Ducks

Ecology
Economics — Wildlife

Fish — General
Fish Ponds
Feed and Cover — General
Foods — Food Habits
Forestry — General
Fox
Fur Bearers — General
Fur Farming

Grouse

Habitat Character
Hawks and Owls
History — Wildlife

Insects

Laws — Wildlife
Livestock — Wildlife

Mammals — General
Management — Farm Game
Management — Forest Game
Management Land
Mink
Muskrat

Nesting Structure

Opossum

Plants — General
Predation
Propagation

Quail

Rabbit
Refuges — Wildlife
Research — Wildlife

Restocking
Rodents

Skunk
Snakes
Soils
Squirrel

Techniques — Wildlife
Tracks
Trapping
Turkey — Wild

Utilization — Wildlife

Waterfowl (other)
Weather
Woodchuck
Woodcock

Use the observation card to record observations of areas as noted by your instructor.

When filing your observations, use key cards with the appropriate classification and file all similar classifications together. Note related observations on front of key card.

Nesting Structures

See also, observation

#110

#87

#92

STUDENT WORKSHEET #1 — Key

Taking Field Notes

After discussing the necessity and usefulness of field notes with the class, assign a scouted area for the class to record their observations. Ask students to read their observations and compare the information included.

Sample Observation:

A female fawn deer was found beneath a multiflora rose bush approximately 100 yards southwest from the intersection of roads 950E and 110N. The deer's right shoulder was broken with three right ribs protruding through the hide. A large pool of dried blood was located beneath the carcass indicating possible bleeding to death. Several flesh wounds were found on the exposed flesh, apparently made by small omnivores or carnivores after the time of death.

An extension of this activity is to make a photographic record of the scouted area and compare these pictures with the observations recorded. This activity will emphasize the need for accuracy of observation.

Students could then be allowed to use a camera to aid in making field observations.

Photographs can record:

- General habitat
    - Succession type
    - Condition
- Ground cover
    - Density
    - Changes (before, after)
- Habitat improvement practices
- Field techniques
    - Equipment
    - Structures
- Animal signs
- Animal damage

Information can be recorded on the back of the photo such as:

No. ______________ Date ____________

Location ____________________________

Legend _____________________________

Author _____________________________

Elements to consider when taking photographs:

1. Make the point of the photograph obvious. PLAN!
2. Take the picture from different angles.
3. Avoid long range shots.
4. Include close-ups.
5. Show scale.
6. Keep unnatural objects out of the picture.
7. Use flash when in doubt.
8. Crop pictures to show essential detail.

STUDENT WORKSHEET #2

Northern flickers are a very common woodpecker throughout much of Illinois. They frequently nest in farm groves, orchards, woodlots, and in urban areas. Unlike most other woodpeckers, flickers usually forage for ants and grubs on the ground in crop fields and in grassy meadows and yards.

The "secret" of success in attracting flickers is to use 1 ½" cedar boards for nest boxes and to fill the interior of the box all the way to the top with sawdust. Tamp in the sawdust before April first so the box is ready when the flickers arrive. This house should have a hinged roof to facilitate filling it with sawdust. The filled box simulates a dead tree with soft heartwood. Since the northern flicker is a "primary excavator," it will start at the entrance hole which is provided and throw out sawdust until a suitable cavity is created. Since this box remains filled with sawdust if not used, sparrows and starlings are not a problem. The entrance hole should be 2 ½" in diameter.

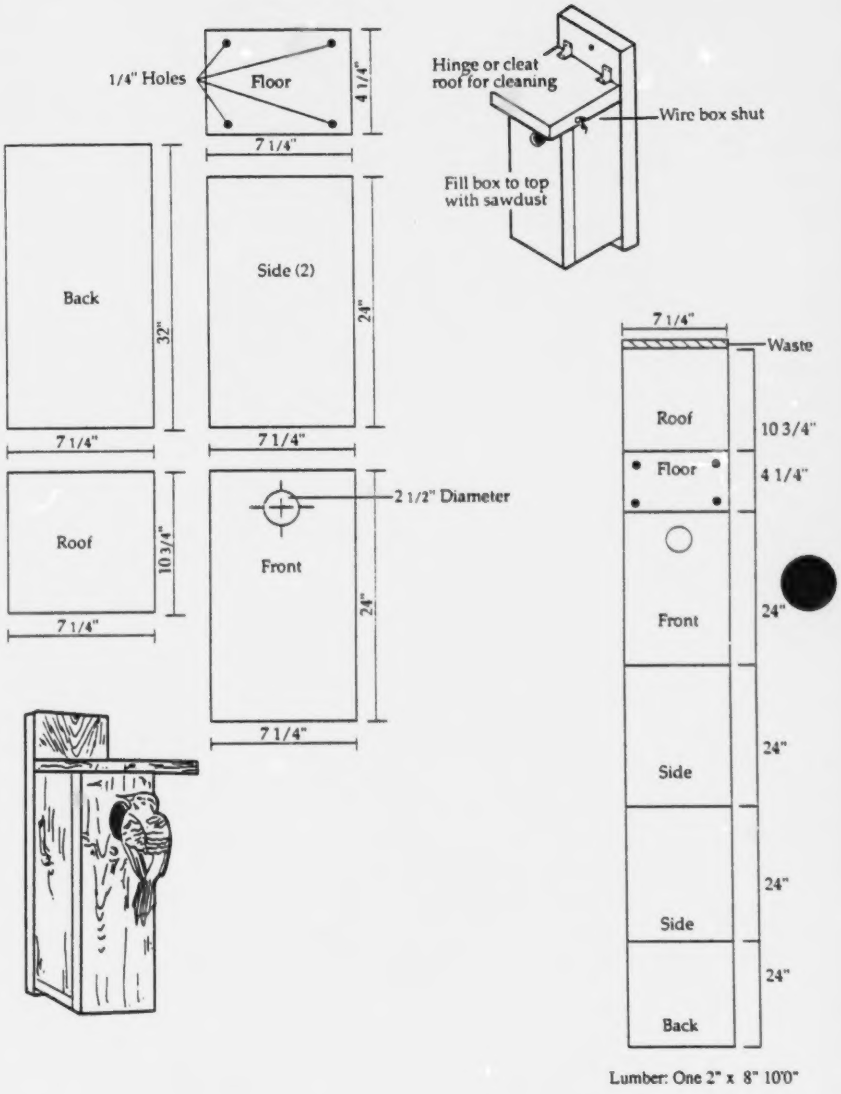
This brilliant nest box idea was developed by Mr. A. J. Boersma of Sioux Center, Iowa.

Flicker boxes should be placed 4 to 6 feet high along fence rows that border crop fields or pastures. Or they may be placed in orchards and woodlots. Flicker boxes can be attached to existing fenceposts or attached to free-standing posts with cedar guards.

Other common woodpeckers in Illinois include hairy woodpecker, downey woodpecker, red-headed woodpecker, red-bellied woodpecker, and yellow-bellied sapsucker. They are all cavity nesters but prefer dead trees over nest boxes.

From Wood Projects for Wildlife, Illinois Department of Conservation

Northern Flicker Nest


1/4" Holes
Floor
4 1/4"
7 1/4"
Hinge or cleat roof for cleaning
Wire box shut
Fill box to top with sawdust
Back
32"
7 1/4"
Side (2)
24"
7 1/4"
Roof
10 3/4"
7 1/4"
2 1/2" Diameter
Front
24"
7 1/4"
7 1/4"
Waste
Roof
10 3/4"
Floor
4 1/4"
Front
24"
Side
24"
Side
24"
Back
24"

Lumber: One 2" x 8" 10'0"

STUDENT WORKSHEET #3

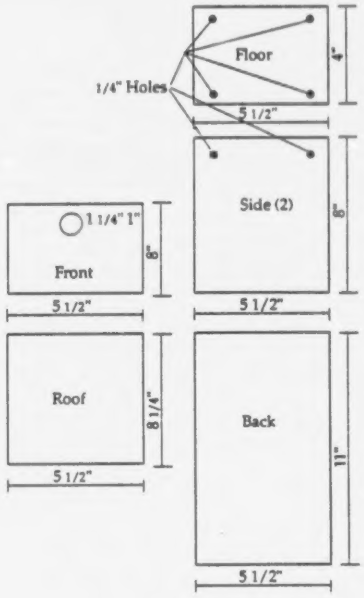
Prairie Deer Mouse and White-Footed Mouse Nest

The prairie deer mouse and white-footed mouse are frequent occupants of nest boxes placed for house wrens, chickadees, and bluebirds. They are distinctively marked by brown or grayish backs, white bellies, long tails, and very prominent eyes. While they may occasionally be a nuisance if they take up residence in a cabin, they are both rather appealing and interesting native mammal species found throughout Illinois.

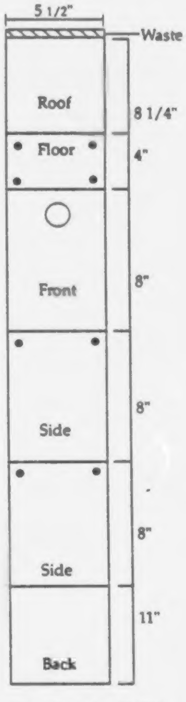
They can be a fascinating occupant of nest boxes in their own right. Some people intentionally place nest boxes for these two native mouse species on fenceposts along fencelines near their cabins or at nature centers. Nest boxes should be on posts about 3 or 4 feet above the ground.

As the mice raise their families they can provide a constant source of enjoyment and fascination for children who may occasionally open the side of the box and peek at the bug-eyed occupants within. Mice will winter in these boxes, so the entry hole should face the east or southeast to avoid prevailing northwest winds.

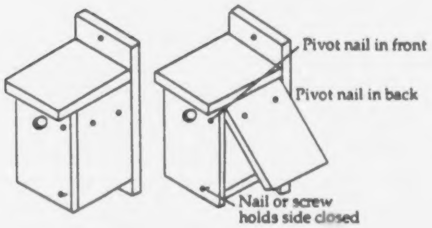
The only problem with mouse use in nest boxes is that if birds return to a songbird nest box in the spring and enter a box occupied by deer mice or white-footed mice, the mice might kill and eat the birds in order to defend "their" box. Nest boxes for house wrens, chickadees, nuthatches, tree swallows, bluebirds, and other small songbirds should therefore be left open in the winter to prevent their use by wintering deer mice and white-footed mice. Boxes intended for these mice should be left closed in winter.



Note: Entrance hole diameter is 1 1/4"



Lumber: One 1" x 6" 4'0"



Two "pivot" nails allow side to swing out for cleaning. Use one nail at bottom to close side.

From Wood Projects for Illinois Wildlife, Illinois Department of Conservation

STUDENT WORKSHEETS #2 and #3 — Key

These two worksheets include plans for nest boxes for two species of wildlife. These worksheets provide the basic information needed to mount the boxes in the proper location. The activity can be extended by placing boxes in different locations and tracking occupancy. Additionally, students can do research into the zoological classification and related species. The class as a whole can plan the best site from a number of sites, taking into consideration the factors listed in the transparencies.

UNIT D: Outdoor Recreation

PROBLEM AREAS:

1. Managing Game Preserves
2. Managing Hunting and Fishing Clubs
3. Practicing Hunting Safety
4. Identifying Outdoor Recreational Enterprises
5. Adhering to Laws and Regulations
6. Managing Golf Courses
7. Managing Parks and Recreational Areas

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Outdoor Recreation

PROBLEM AREA: Managing Game Preserves

RELATED PROBLEM AREAS:

1. Understanding the Relationship Between Agriculture and the Environment (Central Core Cluster)
2. Managing Fish
3. Managing Hunting and Fishing Clubs
4. Controlling Wildlife Pests
5. Raising Game Birds and Animals
6. Feeding Game Birds and Animals

PREREQUISITE PROBLEM AREA(S):

1. Conserving Wildlife Resources
2. Maintaining Wildlife Habitat
3. Classifying Game Birds and Animals

LEVEL: Preparatory

OCCUPATIONAL TASKS ADDRESSED:

Agricultural Resources Cluster

Duty A: Managing the Recreational Facility

1. Requisition materials, supplies and services
2. Maintain inventory records
3. Maintain equipment maintenance records
4. Follow work schedule
5. Complete business forms
6. Assist in development of resource conservation plans
7. Interpret maps, charts, and aerial photographs

Duty B: Applying Laws, Regulations, and Policies

1. Interpret game and wildlife laws
2. Interpret stream, lake, pond, and groundwater laws

Duty C: Performing Promotional Activities

1. Implement environmental education programs
2. Identify recreational needs and interests of special individuals and groups

Duty D: Managing Facility Flora and Fauna

1. Identify plant communities and dominant species within a selected area
2. Identify native plant species within a selected area
3. Apply pesticides
4. Identify wildlife species within a selected area
5. Identify endangered or exotic species of plant and animal life in a selected area
6. Monitor an ecological burn

Duty F: Using Tools, Materials, and Equipment

1. Maintain grounds using power equipment
2. Use hand tools
3. Perform preventative maintenance on tools
4. Perform preventative maintenance on equipment

Duty G: Assembling, Servicing, and Maintaining Equipment and Facilities

1. Follow a facility and grounds maintenance schedule
2. Report facility and grounds maintenance needs
3. Inspect structures and conveniences needing maintenance
4. Maintain grounds and recreation areas

STATE GOALS FOR LEARNING

In planning the instruction for this problem area, teachers can promote the development of several student learning objectives which are related to the State Goals for Learning in Biological and Physical Sciences and Social Sciences. These objectives are listed on the Learning Assessment Plan forms included on the following page(s). Those learning objectives marked with an asterisk (*) are taken from the sample lists provided by the Illinois State Board of Education.

CORE
Illinois Agricultural Core Curriculum
Agricultural Education 124 Mumford Hall 1301 W. Gregory Drive University of Illinois Urbana, IL 61801

Director: Dale A. Law, Ed.D.
Principal Investigator: Jerry D. Pepple, Ed.D
Research Assistant: Robert E. Petrea

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

Submission Date ____________________
☐ Original submission ☐ Revision
Page ____ of ____

(Affix label or complete district information.)

COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐

District Name

City

Contact Person: ____________________
Title: ____________________
Phone: (   )

I. LEARNING AREA *(check one)*

☐ Language Arts
☐ Mathematics
☒ Sciences
☐ Fine Arts
☐ Social Sciences
☐ Physical Development/Health

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will have a working knowledge of the principles of scientific research and their application in simple research projects.

III. LEARNING OBJECTIVES

By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:

III. LEARNING OBJECTIVES	IV. ASSESSMENT A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	V. EXPECTATIONS Percent of Students Expected to Achieve Objective
*1. Demonstrate the ability to draw conclusions from collected data.					
2. List and describe various elements in evaluating habitats.					
3. Appraise a particular area on the criterion of food production, availability, and consumption for a specific species.					
713					714

ISBE 41-78 (1/88)

Agricultural Resources
Outdoor Recreation

Managing Game Preserves

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

Submission Date ____________
☐ **Original submission** ☐ **Revision**
Page ____ of ____

(Affix label or complete district information.)

COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐

District Name

City

I. LEARNING AREA *(check one)*

☐ Language Arts
☐ Mathematics
☒ Sciences
☐ Fine Arts
☐ Social Sciences
☐ Physical Development/Health

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will have a working knowledge of the social and environmental implications of technological development.

Contact Person: ____________
Title: ____________
Phone: (   )

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Identify major factors which affect population growth and decline.					
*2. Understand ways that people can minimize the depletion of the earth's resources.					
3. Select positive management practices for specific game species.					
4. Describe the adverse effects of specific practices for selected species of game animals.					

Managing Game Preserves

4

Illinois Agricultural Core Curriculum Rev.

Agricultural Resources
Outdoor Recreation

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

Submission Date ____________________
☐ Original submission ☐ Revision
Page _____ of _____

I. LEARNING AREA *(check one)*
☐ Language Arts
☐ Mathematics
☒ Sciences
☐ Fine Arts
☐ Social Sciences
☐ Physical Development/Health

(Affix label or complete district information.)

COUNTY	DISTRICT	ESC

District Name

City

Contact Person: ____________________
Title: ____________________
Phone: (   )

II. STATE GOAL FOR LEARNING
As a result of their schooling, students will have a working knowledge of the concepts and basic vocabulary of biological, physical, and environmental sciences and their application to life and work in contemporary technological society.

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Understand the interactions among populations of plants, herbivores, and carnivores.					
*2. Identify interactions of predator and prey.					
3. Define terms integral to managing game preserves.					
4. Name and describe techniques to manipulate habitats.					
5. Select positive management practices for specific game species.					

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☐☐☐	☐☐☐☐	☐☐

District Name
City

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will be able to apply the skills and knowledge gained in the social sciences to decision making in life situations.

Contact Person: ____________
Title: ____________
Phone: ( )

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Understand the knowledge and skills required for success in selected fields of work.					
2. Appraise a particular area on the criterion of food production, availability, and consumption for a specific wildlife species.					
719					720

Managing Game Preserves

Illinois Agricultural Core Curriculum Rev.

Agricultural Resources
Outdoor Recreation

ISBE 41-78 (1/88)

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Outdoor Recreation

PROBLEM AREA: Managing Game Preserves

STUDENT LEARNING OBJECTIVES

Upon completion of their study of this problem area, students will be able to:

1. Define terms integral to managing game preserves.
2. Name and describe techniques to manipulate habitats.
3. Select positive management practices for specific game species.
4. Describe the adverse effects of specific practices for selected species of game animals.
5. Identify and describe benefits to non-game wildlife of specific game management practices.
6. List and describe various elements in evaluating habitats.
7. Appraise a particular area on the criterion of food production, availability, and consumption for a specific wildlife species.

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Outdoor Recreation

PROBLEM AREA: Managing Game Preserves

PROBLEMS AND QUESTIONS FOR STUDY

1. What is meant by managing a game preserve?
2. What are different types of game preserves?
3. What are the various ways to manipulate a habitat?
4. Are the same techniques for manipulation good for all wildlife?
5. What are some positive management practices for upland birds? Forest birds?
6. What management practices benefit water fowl? Fur bearers?
7. Which management practices adversely affect wildlife habitats?
8. Do practices that adversely affect one species of wildlife always adversely affect other wildlife species?
9. What habitat management practices benefit non-game wildlife?
10. How do game management practices benefit non-game wildlife?
11. What should one look for in a habitat for a particular species?
12. How can one use the elements of a habitat to evaluate that habitat's usefulness?
13. What factors affect the potential wildlife population in a particular area?
14. What is mortality?
15. How does mortality affect the wildlife population?
16. What are the different causes of mortality?
17. How can one appraise and evaluate habitats?
18. What specific factors should one use in evaluating a habitat?

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Outdoor Recreation

PROBLEM AREA: Managing Game Preserves

SUGGESTED TEACHING ACTIVITIES AND PROCEDURES

1. Use resource personnel from the Soil Conservation Service of Illinois, Illinois Department of Conservation (Wildlife Resources, Forest Resources, Natural Heritage), Illinois Natural History Survey Wildlife Specialists, Conservation Police, U.S. Department of Interior (Fish and Wildlife Service), Cooperative Extension Service, local landowners, local members of organizations of Pheasants Forever, Quail Unlimited, or Ducks Unlimited, local members of sportsmen clubs, etc., for additional specific information.

2. Use Information Sheet #1 for specific terms integral to game preserve management and the concepts involved in the considerations that must be viewed for successful preserve management.

3. This problem area has been artificially separated from the problem areas *Feeding Game Birds and Animals* and *Managing Hunting and Fishing Clubs*. The preserve itself, an area for maintaining and protecting, has certain fundamentals of manipulation and evaluation. These are necessary regardless if it is a game farm, an established clearing in a dense woods, an area modified or improved for fee hunting, or odd area management on a grain or livestock farm. These fundamentals will be covered in this problem area. *Feeding Game Birds and Animals* will deal with specific requirements for individual species. The food requirements of the concerned species will, of course, be an element in the decision-making process of managing any specific game preserve for reaching its objectives. The problem area *Managing Hunting and Fishing Clubs* will be focused toward the additional requirements of those particular enterprises, such as licensing and population management.

4. Use Information Sheet #2 as a resource for management practices that benefit the included species. Additional information can be found in the *Conserving Wildlife Resources* problem area.

5. Student Worksheet #1 can be used as individual or class projects for practical experience in meeting one of the basic habitat requirements, cover, for the included species. The activity can be extended by requiring student research into zoological classification, feed requirements, related species, etc.

6. Student Worksheet #2 provides specific evaluation criteria that can be used for reconnaissance evaluation of habitats and steps in appraising a wildlife habitat. Section I can be used to do a reconnaissance evaluation of a habitat for a selected species. Section II may be used to acquaint the students in appraisal methods.

7. Use the referenced texts and publications for additional information on managing game preserves.

8. Lead students in a discussion of the various types of game preserves and the value and use of each.

9. Lead students in a discussion of the merits of the information included in current or potential SOE or SAE projects. Consider possible FFA activities that can include this information.

10. Consult with the Illinois Department of Conservation concerning a possible field trip to an activity such as a controlled fire or a trap and release program.

11. Lead students in a discussion of how management of a preserve area for game can influence non-game wildlife. Point out the similarities in habitat requirements of selected game and non-game wildlife. Use Student Worksheet #1 as an example.

12. Invite a member of a group such as Quails Unlimited, Ducks Unlimited, or Pheasants Forever to the class to explain their organization and its objectives. Lead students in a discussion of how these objectives relate to game preserve management.

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Outdoor Recreation

PROBLEM AREA: Managing Game Preserves

REFERENCES

1. *More Wildlife for Recreation.* U.S. Department of Agriculture, Soil Conservation Service, Lincoln, NE 68501.

*2. *Wood Projects for Illinois Wildlife.* Illinois Department of Conservation, Division of Natural Heritage, 600 N. Grand Avenue West, Springfield, IL 62706. (217) 785-8774.

*3. *Wildlife Conservation and Management Curriculum Guide for Vocational Agriculture/ Agribusiness (#1853).* (1984). Louisiana Department of Education, Office of Vocational Education, Box 94064, Baton Rouge, LA 70804-9064.

*4. *Wildlife Management Techniques.* Giles, Robert A., ed. (1980). The Wildlife Society, Inc., Suite 5176, 3900 Wisconsin Avenue N.W., Washington, DC 20016.

5. *Practical Wildlife Management.* Burger, G. V. (1973). Winchester Press, 460 Park Avenue, New York, NY 10022.

6. *Wildlife Management.* Giles, R. H., Jr. (1978). W. H. Freeman and Co., 4419 West 1980 South, Salt Lake City, UT 84101. (801) 973-4660

*7. Illinois Department of Conservation. Various publications and pamphlets.

8. *Introduction to Wildlife Management.* Shaw, J. H. (1985). McGraw-Hill, Inc., Princeton Road, Hightstown, NJ 08520. (609) 426-5254.

9. *Wildlife Conservation Employee #0050.* Cooperative Training Course. Instructional Materials Service, P.O. Box 2588, Texas A & M University, College Station, TX 77843-2588.

*Indicates highly recommended reference

INSTRUCTOR'S NOTES AND REFERENCES

724

INSTRUCTIONAL RESOURCES

These resources are intended for use by teachers in planning and teaching the materials for this problem area and may be adapted to fit the teaching method(s) used.

INFORMATION SHEET #1 — Terms to be Defined

INFORMATION SHEET #2 — Management Requirements

TRANSPARENCY MASTER #1 — Habitat Manipulation (with discussion guide)

TRANSPARENCY MASTER #2 — Factors Affecting Wildlife Populations (with discussion guide)

INFORMATION SHEET #1

Terms to be Defined

Trophic level — number of steps from the primary producers (green plants are the first trophic level) in the hierarchy of obtaining food. Herbivores are considered the second trophic level, carnivores the third trophic level. Aquatic environments may have ten trophic levels with levels 3-10 being carnivores preying on each other. Terrestrial environs usually have four trophic levels.

Energy transfer — reference to the second law of thermodynamics that states that energy cannot be transferred in form without enormous amounts of dissipated heat. Most figures of 10% transfer and 90% loss in the energy transfer from one trophic level to another are considered liberal an estimate. This is particularly true concerning birds and mammals that expend much energy in body temperature maintenance.

Biotic succession — predictable change that takes place in the composition of a community through time. Primary succession occurs in previously uninhabited areas as lakeshores, sand dunes, and rock. Secondary succession occurs after storms or fire disturbances. Early succession will be predominated by herbaceous species and tree species with light motile seeds (pioneer species). Mid-succession finds the replacement of pioneer species with more shade tolerant species that eventually outgrow the pioneer. Late successional species will reproduce and continue to develop in their own shade until another disturbance. The succession stage will influence the wildlife present because no species is equally adapted to all stages and each species will reach a maximum adaptability during a specific succession stage.

Edge effect — conclusion that the more edge per unit area the higher the production of wildlife. Also known as *interspersion*. While variety (diversity) refers to the number of species of cover, food, etc., present in an area, it is the *composition* of those types, the relationship of each in association with all the others, that allows the effect to take place. In summary, increases in edge should produce corresponding increases in populations that have rather limited range and can utilize varied habitats, or the increase in habitat diversity should boost species diversity.

Analysis — observations of habitat as it has existed or does exist. A report of characteristics of habitat.

Brood cover — low-lying vegetation such as grasses and forbs which afford protection for young game birds, usually quail and turkeys.

Browse — palatable twigs, shoots, leaves, and buds of woody plants. Terms often used to describe a category of deer foods.

Cover map — map which shows the various types and amount of vegetation.

Density board — used in measuring cover by obstruction to vision. This board also may be used to measure cover height up to six feet.

Escape cover — shrubby or herbaceous cover, hollow trees, water, or burrows that provide a means of getting away when harassed by predators.

Evaluation — analysis plus value judgments made based on a set of human criteria.

Evaluation of wildlife habitat — intensive and extensive efforts to estimate or appraise the value of various segments of the environment for an animal population.

Food availability — designates the quantity of food within reach of the animal in question.

Food consumption — proportion of the available food which has been utilized by the animal species in question.

Food production — includes all food grown or synthesized in one growing season.

Ground cover — vegetation which grows closer to the ground than overstory and understory plants.

Mast — fruit or nuts of such trees as oaks, beech, walnuts, and hickories. These are commonly referred to as hard mast. Soft mast is fruits and nuts of such plants as dogwood, viburnums, grape, huckleberry, crataegus, muscadine, and blackberry.

Nesting cover — vegetation required by birds or animals to rear their young. Examples are tree dens for squirrels or grassy patches in or near openings for quail, turkey, or rabbits.

Ocular estimating — estimate of cover which is done by the eye and put into a scarce, medium, or dense category.

Roosting cover — cover required by game birds. It ranges from idle fields or sparse timberlands for quail to cypress swamps for wood ducks.

Wintering cover — all cover required by game to overwinter. It varies from trees with squirrel dens, to brush cover for quails, and honeysuckle patches for deer.

INFORMATION SHEET #2

Management Requirements

Hungarian Partridge

General — The gray partridge, commonly called the Hungarian partridge, is primarily a bird of the Northern Great Plains. Substantial populations also are found in the Lake States and in the Pacific Northwest. The "Hun" thrives in an intensive small grain agriculture, but he also does well in some areas where corn is the principal crop.

Land management practices most helpful to Hungarian partridges are:

1. Provide good grass nesting cover interspersed with grain fields — as in strip cropping; on drainage ditchbanks, diversion terraces, and roadsides; in field border and grassed waterways. Native-type grass stands are more acceptable to "Huns" than heavy legume or grass-legume hay.
2. Protect the nests by avoiding mowing. Use herbicides, where possible, to control unwanted plants. If mowing is necessary, delay it until after small grain has been harvested.

Range — Hungarian partridge are not wide rangers; few have a cruising range of more than one-half mile. Therefore it is important that food, shelter, and nesting cover be in rather close proximity.

Nesting — Nest building and egg laying usually begin in late April. The nest location is commonly in grassy cover, or wild grass, hay or grain fields along fence rows or roadsides. Eggs are laid at a rate of about two every three days until the clutch is completed in mid-May. The average number laid is about 16, but may vary from 5 to 25. If the first nest is destroyed, the hen usually renests at least once. Renests average about half as many eggs. The eggs are olive color, varying in shade from almost white to a dark olive. The incubation period is 24 days. The peak of hatching usually comes in early or mid-June in the southern part of the range and about a week later farther north.

The edge principle is a strong influence on Hungarian partridge nesting habits. Studies have indicated half of the field nests are generally located within 24 feet of the margin and 70 percent are within 49 feet; 30 percent are within 30 feet of a field corner. Cutting the outer one or two swaths of hay or grain last may give many birds the extra day or two that might make a difference between hatching or destruction.

Maintaining unburned fence rows and controlling grazing also help to prevent losses. The nesting loss of partridge is very high, varying from 60 to 70 percent. The outstanding cause of destruction is usually farming operations.

Cover — The most important cover types for the Hungarian partridge are crop fields and grass lands. Windbreaks, shelterbelts, contour hedges, odd areas of high grass, and cattail-covered sloughs offer good protection, particularly in the winter.

Ducks

General — Ducks nest and rear their young in the northern part of North America, about 80 percent in Canada and Alaska. The remaining 20 percent are produced in the northern United States, especially in western Minnesota and in North Dakota and South Dakota. Wood ducks breed principally in the hardwood forest areas of eastern North America, from Florida and Texas to New Brunswick and Minnesota. There is a small population on the West Coast. Ducks winter in the southern part of the continent, mostly below the 36th parallel.

Ducks require food, cover, and water for their welfare, just as do other forms of wildlife. Land management for ducks is made more difficult by two factors: (1) the need for water areas, and (2) the migratory habits of waterfowl. Maintenance of the breeding areas in the north and the wintering areas in the south are both required to perpetuate the species.

There are two main groups of ducks: (1) the surface feeding ducks, and (2) the diving ducks. Surface feeding ducks feed in shallow water by tipping, sit high in the water with the tail feathers pointing upward, rise from the water with a strong upward bound, and have a color patch (speculum) on the wing that is generally highly colored or iridescent. Some of the species making up this group are the mallard, black duck, gadwall, baldpate, pintail, blue-winged and green-winged teal, shoveller, and wood duck. A total of 16 species are found in North America.

Diving ducks feed by diving, sit low in the water with the tail pointing downward, paddle along the surface before clearing the water on take-off, and have a color patch on the wing that is not bright and that lacks iridescence. There are 20 forms found regularly on this continent. Among the diving ducks are the canvasback, redhead, scaup, and ringneck.

Land management practices of benefit to ducks are:

1. Maintain and improve existing wetland areas, and establish new ones. Those over one acre in size are especially desirable.
2. Place loafing sites (rock piles, bales of hay or straw, floating logs or rafts) in shallow water of potholes, ponds, dugouts, and other water areas at the rate of four or five per acre.
3. Maintain a border of grass 40 to 300 feet wide around marshes, sloughs, potholes, ponds, and other water areas. Control fire and avoid grazing on this border. Protect nests by avoiding mowing or grazing until after July 15. Graze only moderately after that. Use herbicides wherever possible to control unwanted plants.
4. Establish feeding areas in which waterfowl food crops can be grown and then flooded to make them available for ducks.
5. Build water control structures at the outlet of marshes having a reliable water supply. Regulate water levels to provide desired food plants and the desired ratio of cover to open water.
6. Establish ponds on sites providing the greatest length of shallow shoreline and the greatest number of coves. Maintain a good grass cover and as constant a water supply as possible.
7. Construct nest boxes for wood ducks adjacent to ponds, streams, or sloughs having woods and shrubby cover nearby.
8. Prevent silt deposit in ponds, pits, marshes, and sloughs by establishment of such soil conservation practices as grass waterways, strip cropping, diversions, and proper crop rotations.

Range — Home range in the northern breeding areas differs with the species, varying from 2 ½ miles for the canvasback, 1 ½ miles for the mallard, down to 1 mile for the blue-winged teal. The approximate acreages of the home ranges for these species are 1,300, 700, and 250 acres respectively. Mallards generally winter in the extreme southern states, but some ducks such as the blue-winged teal occasionally migrate as far south as central Chile and Brazil.

Nesting — Some ducks return to the northern breeding grounds in early April, with main flights arriving during the latter part of the month. Mallards and pintails arrive first, followed by scaups, with blue-winged teal last. Many birds pair off before they return to the breeding grounds. Very often they will return to the area where the hen had previously nested, or in the case of yearlings, where the hen was hatched. Studies in the Waubay area of South Dakota indicate that early arrivals generally prefer potholes larger than two acres. This was particularly true for blue-winged teal and gadwall. In fact, the distribution of breeding pairs indicates that most birds, about 94 percent, prefer areas larger than one acre. The smaller, apparently less desirable, areas increase in importance as the breeding population of a species increases.

Species vary in time of nesting, but by the middle of June approximately 60 percent of the nests have been started. Clutch sizes vary from 6 to 15, but the average number of eggs laid is about ten. The incubation period for blue-winged teal and shovellers is 21 or 22 days, while birds that lay larger eggs, such as the canvasback, redhead and mallard may vary from 22 to 29 days. The location of the nest also various with species; the average distance for blue-winged teal was 41 yards from the water's edge. Generally 80 percent of the surface feeding ducks will nest within 100 yards of water. Diving ducks usually nest in wet, boggy places, bordering the edges of marshes, ponds, and sloughs, and the nests are often barely above the level of the water. Habitual tree nesters are the woodduck, golden eye, bufflehead, and hooded merganser. Ducks readily renest if their first nest is destroyed.

Cover — Breeding pairs use potholes with very sparse cover or with no vegetation at all. Potholes with excessively dense vegetation are used very little. On the other hand, a certain amount of cover is of value as wind shelter in cold, blustery weather. Intensive land use, involving the plowing and burning of the entire pothole often improves it for use by breeding pairs by removing excess plant cover. Hardstem bulrush is by far the preferred cover for diving duck nesting.

Broods generally are found on larger open water areas. The selection of brood-rearing habitat depends on the availability of a means of escape from predators. This may be furnished by cover sufficient to conceal the brood or by open water of sufficient size and depth so that broods can dive to escape their enemies. Broods are seldom found on potholes less than one acre in size or with less than five inches of water. Areas with no cover are used by broods only if they are at least 20 inches deep and five acres in size. Ducks have been rated in order of decreasing demand for deep water and increasing demand escape cover: (1) canvasback, (2) lesser scaup, (3) ruddy duck, (4) redhead, (5) baldpate, (6) gadwall, (7) shoveller, (8) green-winged teal, (9) blue-winged teal, (10) mallard, and (11) pintail. Thus canvasback broods preferred deep water and demanded less escape cover, while mallard broods preferred more escape cover and demanded less deep water.

Creating the maximum amount of edge between marsh vegetation and open water is a practical method of improving many marshes. Areas overgrown with cattails with no open water may be burned over in the spring prior to the arrival of the ducks. Openings 30' x 30' may be created by spraying cattails with herbicides. Areas surrounded by vegetation may be opened from the shoreline to the open water either by the above methods or by use of dragline or dynamite. Strips 30' wide are recommended. Raising the water level will also drown out many of the cattails. The more edge effect produced the more desirable the marsh becomes for waterfowl. Possibly as much as 50 percent of the shoreline vegetation may be removed.

The importance of loafing spots is generally not sufficiently appreciated. Small islands, knolls, sand-bars, open margins, or exposed mud-flats are valuable for this purpose. Floating logs or rafts firmly anchored to the bottom are used by ducks as loafing, sunning, sleeping, and preening spots. Rock piles and old bales of hay or straw in the shallower portions of a marsh may also serve the same purpose.

Muskrat

General — The muskrat is the nation's greatest fur resource. Its harvest is six or seven times that of any other species of fur animal. This two or three pound animal occurs throughout the greater part of the continent, from Bering Strait and the southern half of Alaska to the Mexican border.

Land management practices most helpful to muskrats are:

1. Protect marshes, sloughs, and ponds from grazing.
2. Build water control structures at the outlet of marshes having a reliable water supply. Controlling water levels makes it possible to grow preferred muskrat food plants and to make them available to muskrats in the winter.
3. Construct level ditches in shallow marshes on which water levels cannot be controlled. Level ditching is another method of making sure that food will be available for muskrats in the winter. Spoil banks also furnish excellent places for dens. Ditching makes trapping easy; most of it can be done from a boat.
4. Practice controlled burning of marsh vegetation in early spring. Occasional burning keeps dead vegetation from gradually "filling" the marsh. It also makes trapping easier.
5. Stabilize streambanks by protecting them from grazing, establishing grass on them, and building mechanical structures where necessary.

Range — Muskrats do not forage more than 100 yards from home, but occasionally will go one-fourth mile up or down stream. Movement more than half a mile is probably due to deterioration of the home range or high population pressures.

Breeding — Although at times muskrats are highly polygamous, they eventually pair off and share in building or repairing the house, thereby displaying a tendency toward monogamy. Mating begins in late March and the first young are born in late April or early May. Two or three, and sometimes four, litters are produced annually with an average of six per litter.

At birth the young weigh less than an ounce, are blind, almost naked and helpless. At 14-16 days, however, their eyes open, they have developed fur, they are beginning to nibble on green succulent vegetation, and are able to swim and dive. They are weaned at about four weeks.

Habitat — The muskrat is seldom seen far from water. Its habitat may be in streams, rivers, canals, ponds, lakes, swamps, or marshes. Their homes may be in a bank burrow or in a house constructed of fibrous root masses or stems of aquatic plants growing in the area. A bank den is about six inches wide and eight inches high. It is reached by one or more tunnels five or six inches in diameter and 10 to 50 feet long, with the entrance under water. Houses built of vegetation may vary from 1 ½ feet to 4 feet in height; the entrance is under water. Nesting or dwelling houses are generally elliptical as compared with the smaller (1-1 ½ feet high), more circular "feeding shelters." A "push up" or "breather" is another construction built in the northern states as soon as the ice forms in late fall. Muskrats build these by cutting holes in the ice four or five inches across and pushing roots, waterweeds, and other submergent vegetation through the openings. A 12- to 18-inch mass of vegetation is formed on the ice above the hole and a cavity is formed on the inside which the muskrats use as a shelter, breather, or feeding station. When the ice thaws they collapse.

The three essential requirements to sustain a muskrat population are:

1. An abundance of aquatic vegetation for food and cover.
2. Sufficient fresh or slightly saline water for swimming and proper sanitation.
3. A suitable type of soil for digging canals, underground tunnels, and runways.

Marshes with about 80 percent vegetation and 20 percent open water are the best. Control of water levels is very important since muskrats are affected more by rapid changes in water levels than by changes in type of marsh vegetation. Sudden high water levels in the spring result in drowning of young; prolonged low water levels in the summer can stop breeding and lower the rate of survival. However, a temporary draw-down to expose the soil during the first half of the growing season will promote the growth of cattails and bulrushes, and is important where food is scarce or has been destroyed by an over-population of muskrats. A good summer water level is 6 to 20 inches. In the winter, the water level should be raised to three feet in northern states, to two feet in central states, and to one foot or more where freezing occurs only occasionally.

Establishing level ditches four to five feet deep will improve a shallow marsh by providing sufficient depth to allow the muskrats to find food during the winter. It also tends to concentrate the muskrats for harvest. Other methods of increasing population are blasting openings in heavy vegetation, and controlled burning. Burning, however, should never be attempted when the area is completely dry (at least three inches of water), on windy days, or over more than one-third of the area at one time. While the beneficial effects of marsh burning appear to outweigh any unfavorable ones, the owner should always consider the value the marsh has for winter game bird cover. Burning indirectly controls insects, provides open water areas for muskrats and waterfowl, and prevents elevation of the marsh through accumulation of dead vegetation.

Principal predators of muskrats are raccoons, minks, and foxes.

Wild Turkey

General — The wild turkey is primarily a bird of the forest. This truly all-American bird once ranged over all of the eastern United States and west to Colorado and central Arizona. Its present range has been restricted drastically, although there are token populations as a result of stocking in such states as Michigan, Wisconsin, South Dakota, and North Dakota. A favorable land-use pattern for a substantial wild turkey population consists of:

1. An area of 10,000 to 20,000 acres at least 65 to 75 percent forested. The forest should be in a natural state and of such composition so as to provide food and winter shelter. Both oaks and conifers are important in filling these needs.
2. Openings or cultivated fields and pastures should cover 10 to 25 percent of the area. Some opening in the forest canopy every mile would be ideal. It might be added that a low human population is very important.

Land management practices most important to the wild turkey are:

1. Control of fire and grazing in both forest and fields.
2. Selective cutting in forests leaving poorer timber sites in relatively open stands and leaving an ample supply of food trees.
3. Reseeding, renovation, liming, and fertilizing of pastures adjacent to and within forested areas.
4. Annual clipping and mowing in late July or August.
5. Establishment of fruit- and nut-bearing trees and shrubs along woods and roads, and in open areas.
6. Development of an adequate water supply with pits, ponds, and springs.

Range — The daily cruising range of the wild turkey is about two miles. With a good interspersion of habitat types, hardwood openings and conifers, turkeys may confine themselves to covering 400 to 1,000 acres daily. Poorer habitats or in areas where turkeys can fly from one ridge to another may result in turkeys using a range up to 8,000 acres or more. The size of the annual range depends on food supplies, cover, and weather.

Nesting — As spring approaches, the winter flocks begin to break up, gobblers begin their calling and strutting and finally collect their harem which averages four to six hens. Nests are well concealed in thickets, fallen tree tops, or at the bases of bushes or trees. The hen usually covers the nest when she leaves. It takes about two weeks to lay the average clutch of 10 to 11 eggs. Clutches may vary from 8 to 17 eggs. Incubation takes 28 days and a hen will quickly desert her nest if disturbed. Nesting success is usually under 50 percent. By late summer the brood is usually reduced by 25 percent, but broods may combine and large flocks are often seen. Unsuccessful hens may also join the group. The family (hens and poults) stays together until the next spring. In late winter flocks will form according to sexes until the break-up again comes during the "gobbling" season.

Cover — In good range, coniferous and hardwood forest should both be available within each 10,000 acres. Clearing should be of two types: (1) sodded areas that provide grasses for food; insects for the poults; and loafing, nesting, strutting, and dusting areas, and (2) openings created by clear-cut lumbering operations providing succulent fruits and berries such as raspberries, blueberries, grapes, cherries, and dogwood. Good habitat should have

731

a clearing of one or two acres in every 100 acres. Clearings planted to grasses, clovers, or trefoil should be mowed annually in late July or August.

Geese

General — There are distributed throughout the world about 35 forms of geese of which 15, including an Old World visitor, the Barnacle Goose, are regularly found in North America. From earliest times these birds have been important as a source of food or sport. Their down and feathers have stuffed many a comforter, pillow, and coat. Goose quills were the ballpoint pens of past centuries.

Geese belong to the great family of waterfowl, the Anatidae, which also includes the swans and ducks. Swans are the largest in size, ducks the smallest, and the geese are in between. Proportionate neck length follows the same order. Sexes are alike in color.

Geese have plump bodies, short legs, webbed feet, and a high-bridged bill that is fringed on the sides of the gape with plates called lamellae which act as strainers in filtering food particles from the water.

Most species, at the age of two or three years, are believed to mate for life, or at least for the life of either partner. They are very solicitous of the young. Varying numbers of family groups join together to form the familiar V-shaped flocks that indicate the changing seasons to those who live along the migration flyways. The families remain together on the wintering grounds and make the journey north in the same company.

Usually in late summer neither the old nor the young can fly. The young geese have not developed their wings fully and the parents have molted their long flight feathers. When in flight, speeds range upwards to 60 mph.

Land management practices of benefit to geese are:

1. Provide forage by controlled burning of marshes in strip patterns, alternating areas every other year. Begin only in the fall and continue burning swale plots every two or three weeks until mid-winter.
2. Construct and erect artificial nesting devices on islands, in trees, or on dikes.
3. Establish one or more preferred foods in close proximity to wetland areas.
4. Maintain clean, silt-free water in ponds, pits, sloughs, and marshes by applying soil conservation practices such as diversions, stripcropping, grass waterways, and crop residue management.
5. Control depth of water in pond areas by installing water control structures at the outlet.
6. Keep water area open in winter if possible.
7. Preserve, improve, and create wetland areas.
8. Control excessive vegetation in and around ponds.
9. Provide loafing and resting areas such as rockpiles, hay or straw bales, log rafts or floating islands.
10. Establish refuge areas for resting and feeding during migration periods.

Range — The Canada goose, American brant, snow goose, blue goose, and the white-fronted goose winter on both coasts of North America. The Emperor goose, Ross' goose, and the black brant are found only in the West.

Great numbers of geese winter in the tidal marshes and bays of Virginia and North Carolina, Louisiana and Texas, and the Sacramento and San Joaquin Valleys in California.

Often when duck populations are low because of drought in the pothole region further south, goose populations remain relatively high because of their ability to rear young on the permanent water areas of the Arctic.

Nesting — Most geese breed on the arctic tundra. The Canada goose is the exception; it nests from the arctic regions south into New England and northern California.

Geese generally nest on the ground, but occasionally some species will occupy the unused nests of hawks or other large birds located in trees. The Barnacle Goose nests in hilly regions and the nests are usually placed on faces of inaccessible cliffs and precipices.

Some species of geese nest on islands in rivers and lakes or in other reasonably safe areas. Ground nests can be found in grass, brush or sometimes on rocks.

The males, while not assisting in the process of incubation, remain close by and assist in the care of the young.

The incubation period averages somewhat longer than the usual 28 days for ducks.

Cover — Geese are associated with a water environment, whether it be river, lake, pond, or marsh. They seek refuge on large bodies of water during the hunting seasons and fly to neighboring grain fields and grassy areas of large size to feed.

Woodcock

General — Of all the important North American game birds, the American woodcock is probably one of the least known and appreciated. It is, however, one of the finest of our sporting birds. Its deceptiveness and erratic manner of flight through the brush and trees make it a difficult target. The woodcock is very secretive with activities that are mainly crepuscular (at dusk and dawn).

The woodcock is a member of the shorebird family that inhabits grassy fields and meadows as well as lowland woods of the eastern United States and Canada. Chiefly, they are birds of the Atlantic coastal and Gulf coastal states.

Although structurally resembling other members of the shorebird family, the woodcock is easily recognized by its plump body, short thick neck, large black eyes, and squatty appearance. The long, sensitive, probe-like bill, averaging 2 3/4 inches, has a flexible upper mandible independently movable near the tip which acts as a veritable forceps for extracting particles of food from mud or soft earth. The average weight of the male is 5.6 ounces and that of the female is 6.2 ounces. The weight of both male and female increases as the season progresses. Their length is approximately 11 inches.

The American woodcock has been the recipient of many vernacular names in various parts of its range, and some of the more common of these are timberdoodle, snipe, brush snipe, blind snipe, cane snipe, wood snipe, bog borer, bog bird, bog sucker, hill partridge, right partridge, Massachusetts woodcock, and woodhen.

Deer and ruffed grouse have the same general habitat requirements as do woodcock, so any management program for deer and ruffed grouse should also benefit woodcock.

Land management practices most helpful to the woodcock are:

1. Clear-cutting aspen stands to achieve regeneration of aspen-type habitat.
2. Strip-cutting of mixed hardwoods to produce new growth of birch and aspen cover.
3. Disking the soil prior to cutting aspen to help revive partially decadent stands.
4. Improving hawthorn stands by thinning, by selective cutting of inferior species, or by removing competing tall trees.
5. Clear-cutting, during the dormant season, mature and over-mature alder stands to achieve rejuvenation.
6. Establishing alder coverts by planting two- and three-year-old seedlings or by direct seeding.
7. Practicing release cuttings in gray dogwood thickets.
8. Maintaining such species as silky dogwood, willow, gray birch, and blue beech by cutting at about 20-year intervals.
9. Practicing controlled light burning to provide better feeding areas.
10. Establishing hedgerows of fruit-producing shrubs to break up larger fields, in order to provide two or more areas that serve as singing grounds and nesting cover.
11. Preserving wetland areas.
12. Planting rows or groups of gray and silky dogwood, hawthorn, and alder at 50-yard intervals in bottomlands, as a nucleus from which thickets will spread.

Range — The woodcock breeds throughout a range extending on the east through northern Nova Scotia, New Brunswick, Prince Edward Island, southern Quebec, and central Ontario; and on the west from southeastern Manitoba, central Minnesota, and South Dakota to eastern Texas. It winters in the southern United States north to New Jersey and the Ohio valley.

Singing grounds — In the spring the male establishes a territory or "singing ground," which it defends against other males, and from which it attempts to attract a female. A courtship performance takes place in the early morning and evening. The male woodcock goes to the "singing grounds" and gives nasal "peents" and an aerial display. During the display the male flies upward in a spiral flight to heights of 200 or 300 feet. During this flight a whistling noise is produced by the wings. Upon reaching the peak of the flight, the woodcock descends in a series of undulating upward and downward movements. When about 30 feet from the ground, the woodcock glides to a place near the spot where the flight originated. Each flight lasts about one minute. The woodcock remains on the ground a short while giving more "peents" and arises again in the courtship flight.

Nesting — Female woodcock generally locate their nests in young, open, second growth woodland covers or at their borders. The nest is usually near water. Most nests consist of only slight depressions; however, occasionally one will be built up to form a rather deeply cupped mound when located in a wet area. Nest materials consist of deciduous leaves, coniferous needles, tiny twigs, and grasses.

Clutch size averages four eggs but sets of two or three occur, especially late in the season. Clutches of five eggs are rare. The eggs are laid at the rate of one a day. The incubation period varies from 19 to 22 days, but averages about 21 days.

The eggs are ovate and have a moderate gloss. They are buff-colored, blotched with rufous. Eggs of a clutch hatch within four or five hours of each other and show a characteristic longitudinal splitting.

The young leave the nest as soon as they are dry. They are brooded much of the time during the first three or four days. Brooding becomes less frequent as they get older.

Woodcock are nearly full grown at about one month. After this it is impossible to differentiate between age and sex without close examination and know-how. The plumage is brown and russet or buff and mixed with gray and black on the upper parts and pale brown on the under parts. The back of the head is black barred with buff. The tail is black tipped with white and very short.

Cover — There are generally four distinct classes of cover which relate to the season used. These are: (1) breeding cover used from the birds' spring arrival through the breeding season; (2) summer (molting) cover used from mid-July to mid-September; (3) early fall cover used from mid-September to mid-October, and (4) late fall cover used from mid-October until migration occurs. Such cover includes aspen, alder, willow, hawthorn, chokecherry, crabapple, dogwoods, brambles, red maple, hazel, and second growth mixtures of hardwoods.

Non-Game Birds

General — The non-game birds considered here are songbirds, marsh birds, woodpecker, hawks, and owls. The bobwhite quail and mourning dove are included even though they are game birds.

These birds are attracted to farms, ranches and small holdings by the application of soil and water conservation practices. In addition to helping control insects and small rodents, birds offer many hours of recreation to people who enjoy seeing them about their homes.

Land management practices of benefit to non-game birds are:

1. Protection of marshes, ponds, woodlands, streambanks, and odd areas from livestock.
2. Management to provide shrubby fencerows as opposed to "clean" fencerows.
3. Prevention of overgrazing of pastures.
4. Use of strip cropping and crop rotations.
5. Construction of ponds.
6. Special management of the areas listed below.

Hedgerows — The low woody vegetation of hedgerows is the desired habitat of many songbirds. Multiflora rose (thorny or thornless), bush honeysuckle, autumn olive, highbush cranberry or any of several other shrubs make effective hedgerows along field borders and around gullies or farm ponds. These plants attract the catbird, cardinal, mockingbird, cedar waxwing, brown thrasher, indigo bunting, mourning dove, and others.

Hedgerows can be established by planting seedlings by hand or with a tree planter, or by the "plow-perch" method. That is, in summer or early fall plow a six foot strip where a hedgerow is wanted. Set fence posts in a straight or staggered line at about 20-foot intervals down the center of the plowed strip. String wire or binder twine between them for perches. Fruit eating birds will plant their choice foods including wild cherries, blackberries, dogwood, elder, mulberries, and many others. These "plow-perch" plantings grow almost as fast as the other kinds.

Fencerows — When allowed to develop naturally, fencerows in many states grow into shrubby borders and can be maintained as such by cutting out elm, ash, or other tall trees as they appear. Shrub borders harbor many beneficial insects and small mammals and are of much more value to the farmer from this standpoint than grassy fencerows. Shrubby fencerows are used by such birds as quail, cardinal, goldfinch, mockingbird, and chipping sparrow.

Headlands — This term is used to identify the grassy strip at the end of a cultivated field where the farmer turns his machinery. Ground nesting birds as the meadowlark, marsh hawk, song and field sparrows, bobwhite quail, and some warblers feed and nest in them. Headlands, 15 to 20 feet wide, may be established by direct seeding or by leaving the areas unplowed when converting a meadow to the production of grain crops.

Roadsides, streambanks, and ditchbanks — These sites are much used by the birds listed for hedgerows and headlands. Ground nesters use them if they are in grass, whereas the tree and shrub nesters occupy them if woody cover is dominant. Grazing, mowing, spraying, or burning of these areas should be avoided except as needed to control unwanted plants.

Odd areas — Corners of spacious lawns, field corners, gullies, and the fenced area of ponds planted to clumps of trees, shrubs, and vines are attractive to birds. To be of most use, the clumps should cover an area not less than ten feet square. Cedars, spruce, pine, Russian olive, autumn olive, honeysuckle, multiflora rose, wild grape, and bittersweet are some of the plants useful in these locations. Clumps can be established by the "plow-perch" method, by allowing these restricted areas to develop naturally, or by direct planting with seedlings.

Mature woodlands — Tall trees are nesting places for the great horned owl, red-tailed hawk, bald eagle, Baltimore oriole, scarlet tanager, and others. Dead trees invite flickers, redheaded woodpeckers, sapsuckers, bluebirds, house wrens, and screech owls which nest in hollow trunks or limbs. To provide for these species leave dead trees in the woodland or kill two or three tall, unwanted trees per acre. Killing is best done by "ringing" the trunk — that is, cutting the cambium layer in a strip two or three inches wide around the tree at breast height. Grasses and shrubs will appear in the area formerly shaded by the canopy and will attract birds other than the kinds noted above.

Woodland clearings — Dense, mature woodlands seldom harbor many small birds. To encourage more use it is necessary to increase food production and the variety of plants within the wooded area. To do this, select trees as wild cherry, hackberry, oak, beech, or hickory and apply the orchardist's method for producing more fruit. Measure the diameter of the fruit tree in inches at 4 1/2 feet above ground, multiply the diameter by three, substitute feet for inches. This gives the length of each side of a square centered on the selected tree. Remove all trees within the square except the one to be favored. Example: The selected tree is 10 inches in diameter at 4 1/2 feet above ground. Multiply 10 x 3 = 30 inches. Substitute feet for inches. This makes the length of each side of the square 30 feet. Center the tree in this square and remove all other trees. A surprising number of shrubs, grasses and new birds will appear.

Wetlands — Many kinds of birds, from wild swans to tiny marsh wrens, are attracted to wetlands. The kinds and numbers depend on the size and location of the wet area, its degree of wetness and the plant and other animal life present. There are several kinds of wetlands:

1. *Ponds* — A dam constructed across a drainageway offers the best means of creating a wetland habitat. Ponds so created attract mourning doves, snipes, killdeers, herons, and a number of others. The fenced area surrounding ponds can be developed by growing clumps of trees, shrubs, and vines in the corners and along the fence. Woody plantings closer than 30 feet to the water will interfere with fishing. Keep them well back from the shoreline.

2. *Pits* — These are sometimes called "dugouts" and are constructed by digging in land having a high water table (one foot or less below the ground surface) or in a relatively flat drainageway where runoff will keep the pit filled with water. The environs of pits can be developed in much the same way as ponds to attract songbirds.

3. *Marshes* — Natural and man-made marshes support a myriad of plant and animal life. A marsh can be built on a couple acres of fairly flat land where soils are tight enough to hold water or the water supply is sufficient to compensate for limited seepage. The construction of a dam or dike is usually necessary. The simple marsh will range in depth from one inch to three feet or more. A more elaborate marsh may have a depth of several feet at one end with most of the remainder covered by one or more inches of water. The deep end is suited to swimming, boating, and fire protection while the shallow area will grow marsh vegetation. Vegetation may become so dense as to eliminate all open water in a shallow marsh. It is important to have some open water areas scattered about the marsh. These can be created during the early construction stage by digging pits to provide minimum-sized water areas of 100 square feet from two to four feet deep. Two to five such areas per acre of marsh are desirable. The spoil should be piled where there is no danger of its sliding back into the excavation.

Native marsh plants will ordinarily invade the new area making planting unnecessary. Circling the marsh with a row of shrubs or planting clumps of trees and shrubs as described above adds to its beauty and usefulness.

A greater degree of management is possible if a water-level control device is installed in the dam. By fluctuating the water level the owner can reduce unwanted vegetation or encourage desirable plants.

Artificial measures — Bird houses may be constructed and located within a developed area. These do not take the place of good habitat; they merely entice birds to places where they can be more easily seen. Among the birds known to use bird houses are the bluebird, chickadee, flicker, house wren, martin, screech owl, sparrow hawk, tree swallow, some warblers, and the woodduck.

From *More Wildlife for Recreation*

TRANSPARENCY MASTER #1

Habitat Manipulation

Advancing Succession

- Planting
- Construction of Cover

Setting Back Succession

- Fire
- Grazing
- Logging
- Mechanical Techniques
- Herbicides

Edge Manipulation

Mitigation

TRANSPARENCY MASTER #2

Factors Affecting Wildlife Populations

Potential Population -

Harvest Numbers

+

Predator Toll

+

Starvation

+

Disease Toll

+

Accidental Loss

+

Poaching Loss

=

Actual Population

737

TRANSPARENCY MASTER DISCUSSION GUIDE

Transparency Master #1

Habitat manipulation refers to adjusting the successional stage to make the management area better suited to the desired species. Additional considerations related to habitat manipulation are maintenance of pristine conditions (forego manipulation), maximization of wildlife diversity (limited to moderate disturbances), or maintenance of highest population (early to mid-successional stages).

Advancing Succession — Will advance naturally as long as disturbances do not intervene. The drawback to this action is time, which leads to preservation efforts for advanced successional plots.

Plantings — Must be planned to fit present vegetation. Woody perennials are planted to provide thermal and escape cover, and long-term food supply. Annuals are planted mainly for food.

Construction of Cover — Nest boxes, nesting platforms, brush piles (both dead and living), etc.

Setting Back Succession — Imitation of disturbances that intervene in the natural advance in succession.

Fire — Least expensive, most natural method. Drawbacks of this method include the possibility of the fire getting out of control, the need for seasonal timing, and excessive heat. The method is common in prairies and grasslands, and plants and animals are well adapted to its occurrence. When this method has been used, increases in population and diversity of both wildlife and vegetation have been noted.

Grazing — Natural retardation of succession, subject to overuse if not regulated.

Logging — Sets back succession to favor early to mid-successional species, and provides more browse.

Mechanical Treatment — Bulldozing, disking, or mowing. These treatments are more expensive than fire, but safer and more predictable in outcome.

Herbicides — Very selective, relatively inexpensive, but not recommended because of adverse effects such as found in DDT.

Manipulation of Edge — Refer to Terms to be Defined.

Mitigation — A technique of compensation for habitat lost to development by securing and improving similar habitat elsewhere. The populations disrupted will be offset by population increases in the mitigated area. The Army Corps of Engineers and the Bureau of Reclamation are supposed to mitigate losses of development projects. The cost of the mitigation is to be borne by the developing agency with the selection of site and specific recommendations made by the U.S. Fish and Wildlife Service. Problems encountered are inadequate assessment, poor interagency cooperation, and lack of law enforcement. Problems notwithstanding, mitigation remains an important wildlife habitat technique.

Transparency Master #2

This transparency refers to those environmental filters that must be considered when trying to achieve a desired population of a particular species.

Potential Population — Refers to the food, water, cover, space, arrangement, climate, weather, etc., that will determine the population extreme.

Mortality factors can be classified as:

Density-dependent — Such as disease, starvation.

Density-proportional — Such as a set percentage of the population that will be harvested.

Density-independent — Such as accidents.

STUDENT ACTIVITIES

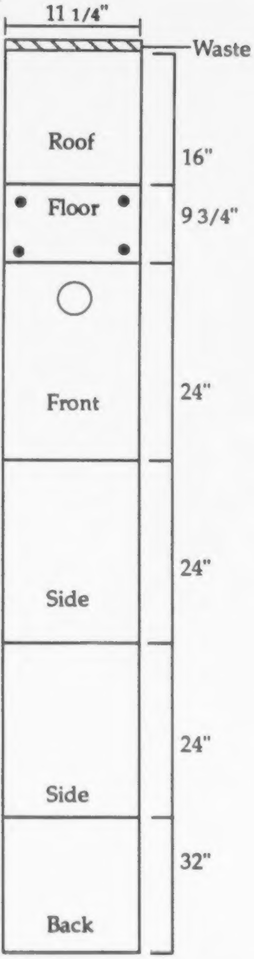
STUDENT WORKSHEET #1 — Wood Duck, Raccoon, Pileated Woodpecker

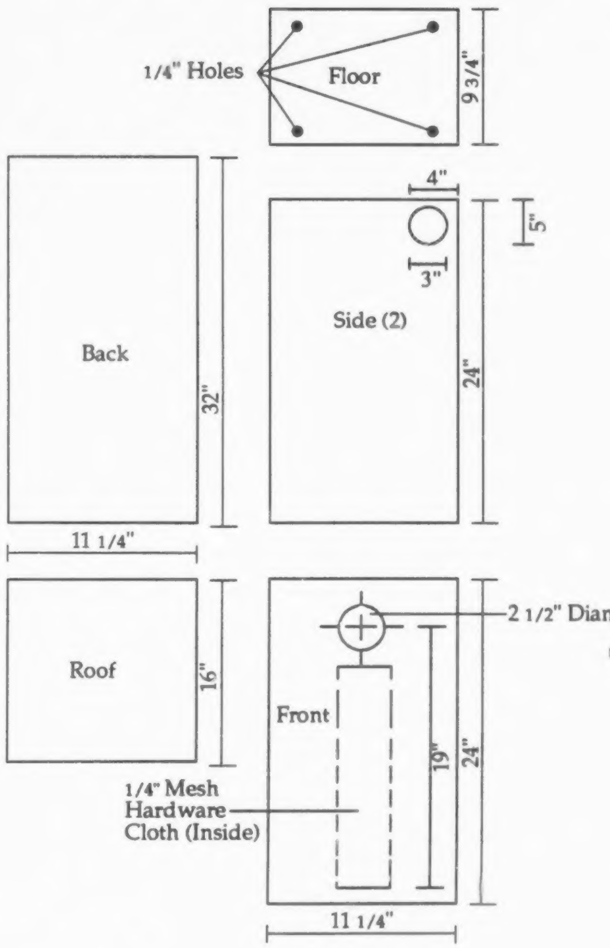
STUDENT WORKSHEET #2 — Reconnaissance-Type Evaluation of Habitat

For additional activities, teachers may refer to the “Suggested Teaching Activities and Procedures” section in the Instructor’s Guide.

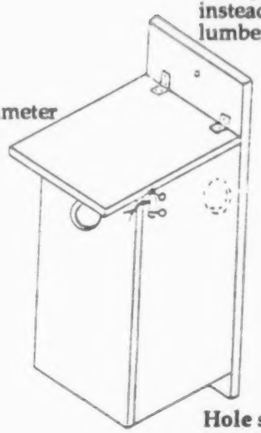
STUDENT WORKSHEET #1

Wood Duck, Raccoon, Pileated Woodpecker


11 1/4"
Waste
Roof
16"
Floor
9 3/4"
Front
24"
24"
Side
24"
Side
32"
Back


1/4" Holes
Floor
9 3/4"
Back
32"
11 1/4"
4"
5"
3"
Side (2)
24"
Roof
16"
2 1/2" Diameter
Front
19"
24"
1/4" Mesh Hardware Cloth (Inside)
11 1/4"

Lumber: One 1" x 12" 12'0"
Note: Pileated Woodpecker box should be constructed from one 2" x 12" x 12'0" cedar, and floor must be 8 1/4" long instead of 9 3/4" for use of 1 1/2" thick lumber



Hinge or cleat roof for cleaning

Optional:
Locate 3" diameter entrance hole here for squirrel box

For Wood Duck house:
Place 3-4" of sawdust in bottom of box

For Pileated Woodpecker house:
Fill box to top with sawdust

Hole size:
Wood Duck 3" high and 4" wide oval
Raccoon 5" high and 9" wide oval
Pileated Woodpecker 4" diameter round

Wood Duck

The traditional wood duck box has helped the beautiful wood duck make a remarkable recovery during the past 20 years. Early in this century some people believed the wood duck was becoming extinct. Now it is one of Illinois' most abundant waterfowl species.

As shown in the design, the entrance hole should be an oval three inches high and four inches wide. This hole excludes most raccoons. The hole should be centered 19 inches above the floor. An 18- by 3-inch strip of ¼-inch mesh hardware cloth should be cut out and the cut edges folded back. This should be attached inside the box under the entrance to function as a ladder for the newly hatched ducklings. Sometimes squirrels will tear this ladder loose so it will need to be checked annually. Or the wood under the entrance hole should be roughened with a chisel to give the ducklings the toeholds they need. The roughened area should extend below the entrance hole for one foot. At least three inches of mixed sawdust and chain saw wood chips should be placed in the nest to serve as nesting material. The roof should be wired so the box can be opened for maintenance. Paired roofing nails with large heads should be used around the top of the box to wire it shut so raccoons can't open the box.

The house should be constructed of wood that is strong and can be made weather resistant. It can be painted, stained, or treated — on the outside only. The floor should be recessed ¼ inch up from the lower edge of the sides to prevent rotting.

Houses can be erected on an isolated tree or on a 16-foot long, 4" x 4" post that is cypress, cedar or preservative-treated wood. An aluminum or tin sheet should be nailed around the post under the house to prevent squirrels and raccoons from entering. Used aluminum printing plates from newspaper offices can be purchased very cheaply and stapled lengthwise to the 4" x 4" post under the nest box. Since wood ducks are not territorial, two or more houses can be placed on the same post.

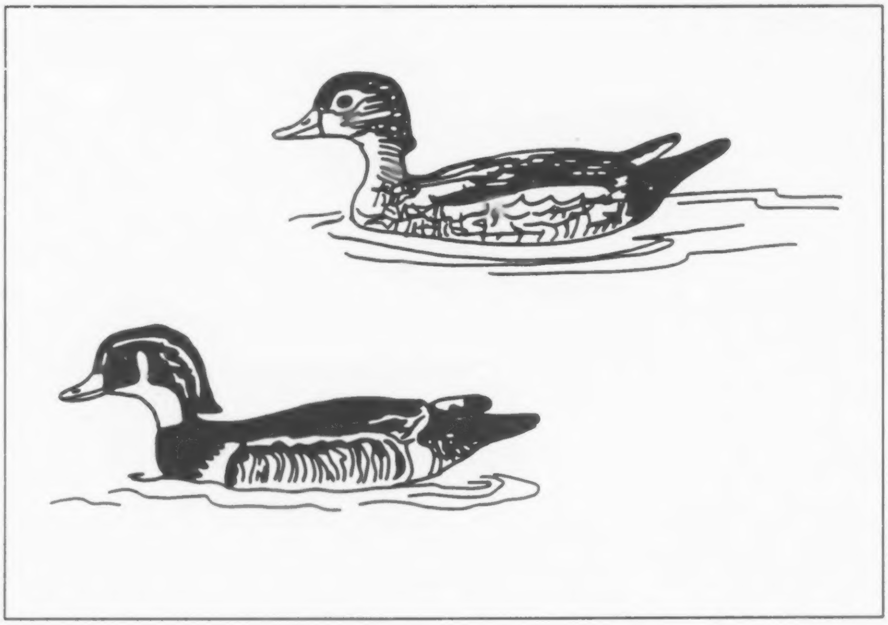
Vigilant starling control will be necessary in wood duck boxes. Remove their nests and eggs whenever they occur. The top of a wood duck box should be fastened to its support so that it leans forward a couple inches. This facilitates the drainage of rainwater. To strengthen the box, nail a 9 ¾-inch-long 1" x 2" along the inside top edge of the front. Nail a similar-sized piece onto the back just under where the roof rests.

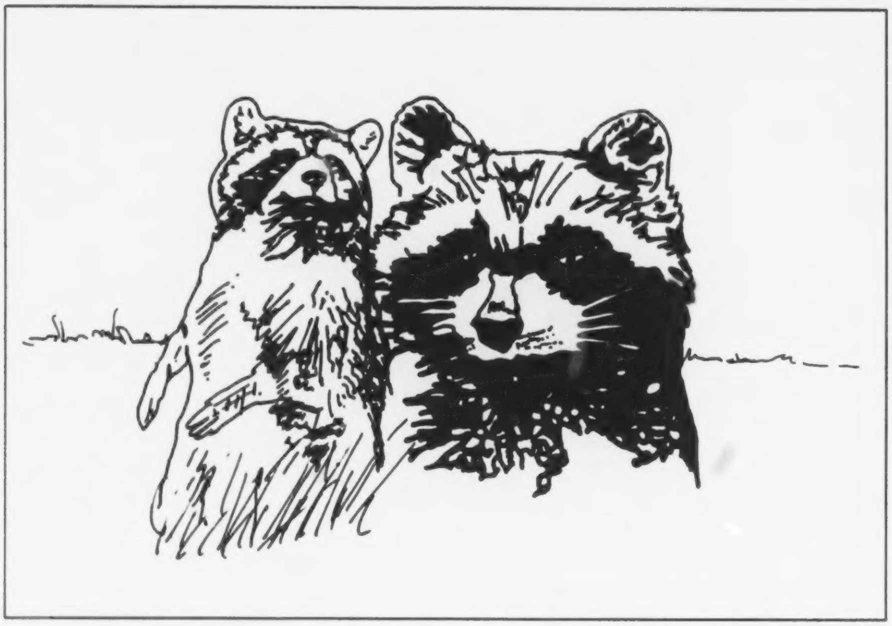
Biologists recommend placing a horizontal piece of slab wood with the bark attached on the front of the box immediately below the entrance hole. This aids the hen in landing and entering the entrance hole.

Boxes placed on posts in water should be about six to eight feet above the water's surface. Wood duck boxes should be placed over water or in woodland habitat up to half a mile from lakes, ponds, marshes, and rivers. Wood ducks nest regularly in most of Illinois. Since the hen must lead her ducklings to water after they hatch, the habitat between the house location and the water's edge should be free of major obstacles like highways, fences with small mesh wire, and street curbing.

Heights above 20 feet seem to be preferred in trees. Aspens should be avoided. Box entrances near water should face the water. Otherwise, there seems to be a slight preference for south and west facing entrance holes. Ideally, boxes on land should be 30 to 100 feet from the water's edge. The chance of predation by raccoons is higher along the water's edge.

Annual maintenance on wood duck boxes should be completed by March 1.





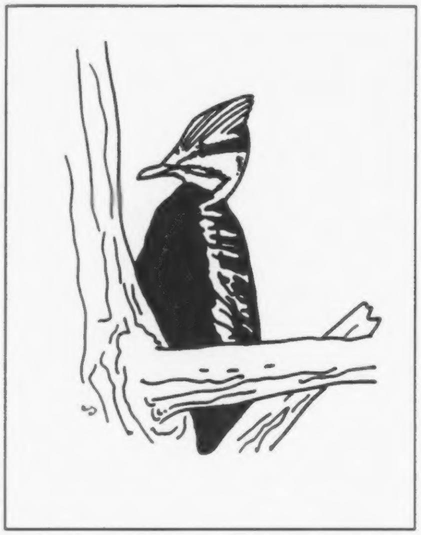
Raccoon

The raccoon is a common mammal throughout Illinois. Most nest box projects are designed to exclude use or predation by raccoons. However, if someone wishes to provide a box which can be used by raccoons, the design given is appropriate. The entrance hole should be five inches high and nine inches wide and face east or south so it is sheltered from prevailing winter winds. The box should be placed on live or dead trees at a height of 10 to 20 feet. The tree should be at least 12 inches in diameter.

Pileated Woodpecker

The distinctive pileated woodpecker occurs in large forested areas and forested stream corridors in Illinois. It is the largest woodpecker in the state — about the size of a crow.

It has not been known to nest in nesting boxes because it is a primary excavator and must excavate its own nesting cavity. However, the breakthrough in attracting flickers developed by Mr. A. J. Boersma of Sioux Center, Iowa, may apply to pileated woodpeckers also. The "trick" is to fill the nest box with sawdust all the way to the top and tamp it in. Then the woodpecker can fulfill its instinct to make its own nest cavity.



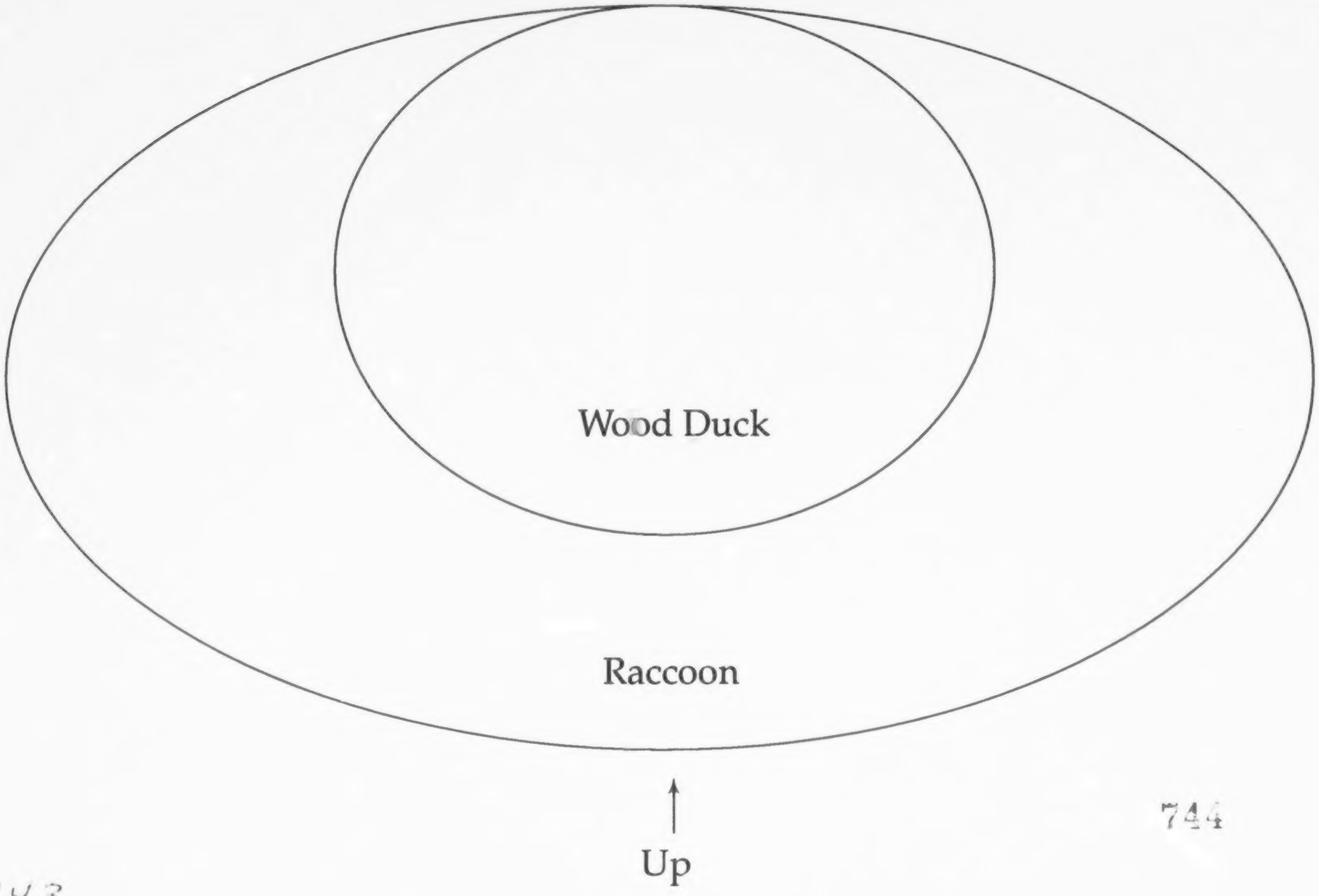
This nest box design is proposed as an experiment for woodland owners, naturalists, and biologists to try. Use the one-board wood duck box design, but use 1 1/2-inch-thick cedar instead of a ¾-inch-thick board as you would for a wood duck house. A 12-foot-long, 2" x 12" board will be necessary to make this box.

Remember that the floor section must be 8 ¼ inches long instead of 9 ¾ inches as in the design.

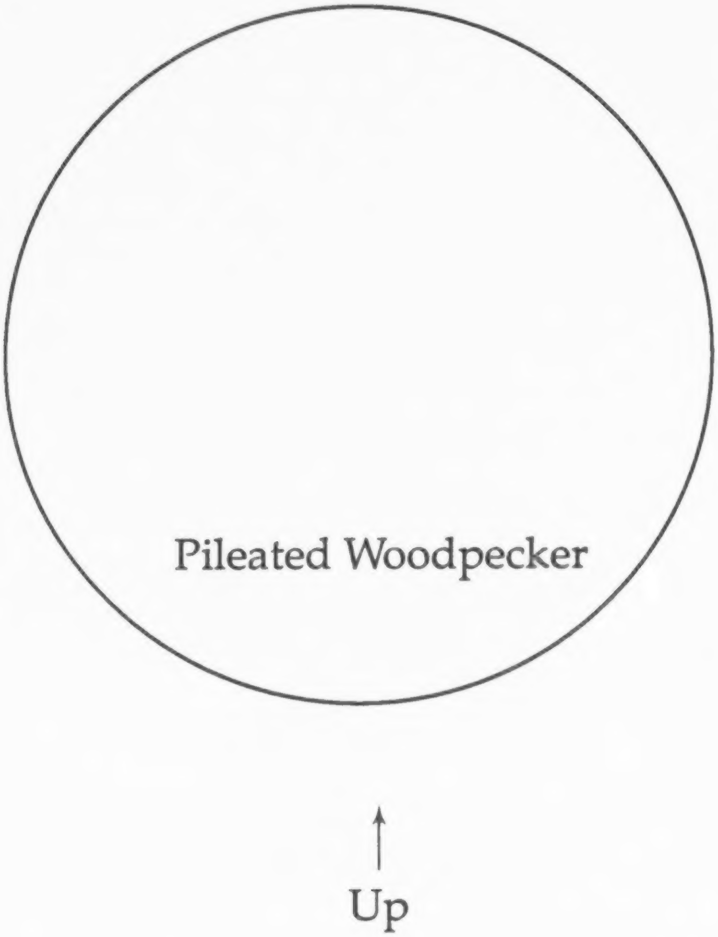
The entrance hole should be four inches in diameter and centered 19 inches above the floor. The top should be hinged to allow filling with sawdust. The entrance should probably face south or east. Sawdust should be tamped into the box all the way to the top.

The box should be placed about 20 to 30 feet high in a live or dead hardwood tree in the interior of a stand of mature hardwoods where pileated woodpeckers are known to occur. Lag screws and washers can be used to attach the house to the tree so it can be loosened as the tree grows — if a live tree is used. Caution: Dead trees are often unsafe to climb and may frequently be undesirable to use for that reason. Please report any nest box use by pileated woodpeckers to the Division of Natural Heritage.

Entrance Hole Guide for Wood Duck and Raccoon Nest Box


Wood Duck
Raccoon
Up

Entrance Hole Guide for Pileated Woodpecker Nest Box


Pileated Woodpecker
Up

STUDENT WORKSHEET #2

Reconnaissance-Type Evaluation of Habitat

I. Evaluation

A. Reconnaissance - Type Evaluation of Habitat

1. Cover Maps

a. Vegetation is the most important aspect of the environment for most forms of game animals. Cover maps are extremely useful for assessing vegetative habitat conditions.

b. Cover maps give a measure of the current habitat conditions. Therefore their value is limited to a short period of years.

c. A problem with cover mapping is now much detail should be included on the map. This problem can be solved by keeping the following factors in mind: (1) the use to be made of the map, (2) the area, or acreage, (3) the time available for mapping, (4) the principal animal species under consideration, and (5) related factors.

d. Cover maps divide vegetative cover into three categories: (1) overstory, (2) understory, and (3) ground cover.

2. Cover Density Evaluation

a. Symbols are used on cover maps to indicate cover density. These symbols are: (1) - Scattered or light, (2) = Medium, and (3) ≡ Dense.

b. Techniques for evaluation of cover density include: (1) ocular estimation, (2) counting the number of stems per sample quadrant, (3) measuring the obstruction of vision, (4) measuring, by photoelectric devices, the influence of cover on exclusion of light, and (5) photography.

1) *Ocular Estimating* — Any experienced field worker can estimate the requirements of a specific wildlife species in regards to the amount of cover needed. The cover can be divided into one of three categories — scarce, medium and dense.

2) *Number of stems per sample plot* — This procedure entails the counting of stems in a sample area.

3) *Measuring obstruction of vision* — This system indicates cover density by the use of a density board. The board is divided into one-foot sections up to six feet tall. It is viewed at a distance of 66 feet. If there is no cover the reading is 21 (1, 2, 3, 4, 5, and 6 are added together); if cover completely obscures the entire board the reading would be zero. The table used in measuring obstruction of vision is as follows:

Percent Obscurity	Classification	Map Symbol
16 to 33	Scarce	-
33 to 66	Medium	=
66 and over	Dense	≡

4) *Measuring cover density by photoelectric equipment* — Another method used consists in taking various measurements with photoelectric equipment of a plot of land which is being used by a certain species of wildlife. The equipment measures the amount of light being admitted through the overstory, understory, and ground cover. The rating of the cover density is as follows:

Percent of Light Admitted	Classification	Map Symbol
More than 75	Scarce	-
51 to 75	Medium	=
0 to 50	Dense	≡

3. Soil Evaluation

   a. One of the most important evaluations that should be made in wildlife habitat analysis is soil evaluation. The type of soil that exists on a certain plat determines the nutritive value of plants which can be detected by wild animals. Published soil maps are the best source of information for such an evaluation. Another method of evaluating the soil is by a soil test which can be conducted by the state soil testing laboratory. Important things to remember about sampling soil are as follows: (1) Use a clean bucket to send samples to the laboratory in boxes provided by your county agent, Soil Conservation Service (SCS) technician, vocational agriculture teacher, or other agriculture workers. Make sure to label, number, and address sample. (2) Take from 10 to 30 small samples from every part of the field, then combine and thoroughly mix the samples. A composite sample should not be less than one quart of soil.

4. Evaluation of Food Production, Availability, and Consumption

   a. Food Production — Criteria used in evaluating food production may be food quality, food plant variety, food requirement value, and the limiting food factor which is the lowest rating value for food criteria. Food production may be determined by the collecting of seed or other portions of plants from sample plots.

   b. Food Availability — Any technique to determine food availability is time-consuming and tedious. No single technique will supply data that will fully meet all needs for scientific range management. A different system of evaluating food availability must be used for different geographical regions.

   c. Food Consumption — Data should be collected over a period of years in order to get the correct information. Key or browse species should be targeted and tagged in a certain area for study.

B. Vegetative Analysis

1. Reconnaissance appraisal of wildlife habitat may not meet all the needs of the wildlife manager. Therefore vegetative analysis is required, which is a measure of one or more of the following:

   a. Presence/absence — Of a given species in a given area.

   b. Basal area — The proportion of ground surface occupied by a species.

   c. Cover — Vertical projection of above-ground parts from the ground.

   d. Frequency — Expression of the percentage of sample plots in which a species occurs.

   e. Density — Number of individuals per unit area.

   f. Dominance — Effect of competition and environmental factors on the position occupied by a species in a stand.

   g. Importance — Is a weighted expression to designate the value of a given plant for a given purpose. This expression may consist of a simple averaging of frequency, density, dominance.

C. Farm-Game Habitat Evaluation

Due to increasing human pressure on land, the need for food and cover by wildlife is often acute. The habitat changes have greatly reduced population of some game species. Wildlife managers have considered the artificial improvement of wildlife habitat by the establishing of food and cover plants as one of the more effective approaches. Habitat development for wildlife may become generally acceptable when hunters are willing to make management of farmland profitable to landowners. Artificially established vegetation must be capable of permanent maintenance with little effort on the part of the landowner. A farm-game habitat should result in increased game populations and harvest. Farm-game habitat evaluation will play an important part in the future of wildlife.

D. Forest Range Evaluation

Forest range condition requirements vary greatly for different species. The amount of food and cover basically determines the relative abundance of hoofed game of most species in forest or range. Besides food and cover, other conditions such as precipitation, temperature, evaporation, and varying use patterns should be considered.

E. Evaluation of Wetland Habitat

Wetlands exceed all other land types in wildlife productivity. Wetlands are lowlands covered by shallow and sometimes temporary or intermittent waters including marshes, swamps, bogs, wet meadows, potholes, sloughs, and river bottom lands. Wetlands are usually divided into either breeding range for production purposes or wintering habitat. Taken into consideration also is the amount of cover on the wetlands. Density estimates were made on the ease with which ducks could penetrate the cover.

II. Appraisal

A. Steps in Appraising a Wildlife Habitat

1. The following procedures describe the method for inventorying existing habitat conditions, rating the element criteria and calculating the habitat quality values.

Step 1: Determine the land user's objectives and the practicability of managing on that operating unit.

Step 2: Select an area which will represent the home range. The home range area should be chosen on the basis of not only the animal requirements but also the practical limits of how the landowner can effectively manage the area.

Step 3: Examine the home range area to assure that all the required elements are present.

Step 4: Evaluate each habitat element by matching conditions with the ratings prepared for the various criteria.

Step 5: Calculate the element values.

$$\text{Element values} = \frac{\text{element criteria ratings total}}{\text{number of element criteria}}$$

Step 6: Calculate the species habitat quality value.

$$\text{Habitat quality value} = \frac{\text{weighted or unweighted element value total}}{\text{number of habitat elements (adjusted for weightings)}}$$

Step 7: Assess what elements or criteria are weak or missing, and plan practices to strengthen them accordingly.

U.S. FISH AND WILDLIFE SERVICE
DIVISION OF ECOLOGICAL SERVICES

FISH AND WILDLIFE HABITAT FIELD EVALUATION SHEET

Page ________ of ________ pages

PROJECT NAME

DATE

HABITAT CODE

HABITAT TYPE

ALTERNATIVE PLAN

SAMPLE SITE IDENTIFICATION NUMBER	EVALUATION ELEMENTS										LINE TOTAL
TOTAL EVALUATION ELEMENT VALUES											

$\frac{\text{Grand Total of All Evaluation Elements}}{\text{Number of Sample Sites}}$ = ____________ =

HABITAT TYPE UNIT VALUE	MANAGEMENT POTENTIAL UNIT VALUE *(Wildlife habitat only)*

INSTRUCTIONS

In order to evaluate the impact of the plan on the fish and wildlife habitat, it is necessary to know the value of the habitat itself. Here, each habitat type is assigned a value according to its worth for fish or wildlife. These resources are to be evaluated separately, and impacts and compensation needs are also computed separately. To determine this habitat type unit value, the evaluation team will complete a Form No. 3-1101 for each habitat type as follows:

1. Select representative species that are dependent to some degree on the habitat type being evaluated and which best express its diversity. These will be used in rating the sample sites. List them across the top of the chart at the left. The reasons for selecting these particular species should be noted and appended to this form. The objective is to consider the full range of animal life in assessing habitat quality. Normally ten species are selected, however the number of species used to evaluate a particular habitat type may vary. If another number is chosen, the rationale for this must be noted on the back of this form. These species, or evaluation elements, may not vary within a habitat type.

2. Select a number of sample sites agreeable to all members of the evaluation team. This number may vary with different habitat types.

3. Rate the capability of the habitat to meet the requirements of each of the evaluation elements on a scale of 1 through 10 at each sample site, the higher rating being given to the more desirable sites. All evaluation elements must be rated at each sample site.

4. The key criteria involved in making the above judgement should be recorded on the back of this form or on a separate sheet and attached.

5. Sum the values in each Evaluation Element column vertically, and write this number at the bottom of the column.

6. Sum each Sample Site line horizontally and sum the Total Evaluation Element Column. Write

SIGNATURE OF LEAD PLANNING AGENCY REPRESENTATIVE

LEAD PLANNING AGENCY

TURE OF STATE REPRESENTATIVE

STATE AGENCY

SIGNATURE OF FWS REPRESENTATIVE

ES FIELD OFFICE

Form No. 3-1101 (MAY 1976)

(Over)

the totals in the spaces provided. Note that if more than ten evaluation elements are used, a second Form No. 3-1101 must be used and the line totals from one sheet carried forward to the second.

7. Divide the Grand Total of All Evaluation Elements by the Number of Sample Sites. If ten evaluation elements were used, this number is the Habitat Type Unit Value for the habitat type being evaluated, and this number should be written in the box provided at the bottom of the Form No. 3-1101. If more or fewer than ten evaluation elements are used, then the number obtained by this division operation must be prorated, for example: if only five evaluation elements are used, then the quotient must be multiplied by 10/5. If twelve evaluation elements were used, then the quotient must be multiplied by 10/12. This product is the Habitat Type Unit Value in these cases and is the number that should be written down in the box at the bottom of the form.

(Additional instructions for wildlife habitat types)

8. Using professional judgement, the evaluation team now estimates the increase in wildlife habitat type unit valu possible by proper management of the resources presen This is the Management Potential Unit Value. Write this number at the bottom of the form in the box provided. The sum of this number and the Habitat Type Unit Value must not exceed 100. If they do, the Management Potential Unit Value must be reduced accordingly.

9. For wildlife habitat, an interspersion value may be determined. If this is done, the evaluation continues on Form No. 3-1102.

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Outdoor Recreation

PROBLEM AREA: Managing Hunting and Fishing Clubs

RELATED PROBLEM AREAS:

1. Classifying Fish
2. Stocking Fish
3. Feeding Fish
4. Controlling Wildlife Pests
5. Practicing Hunting Safety
6. Adhering to Laws and Regulations
7. Classifying Game Birds and Animals
8. Feeding Game Birds and Animals
9. Raising Game Birds and Animals

PREREQUISITE PROBLEM AREA(S):

1. Maintaining Wildlife Habitat
2. Managing Game Preserves

LEVEL: Preparatory

OCCUPATIONAL TASKS ADDRESSED:

Duty A: Managing the Recreational Facility

1. Complete weekly receipts
2. Complete invoices
3. Requisition materials, supplies, and services
4. Maintain inventory records
5. Follow work schedule
6. Contribute to annual park management update
7. Identify specific recreational program needs for visitors
8. Complete business forms
9. Communicate orally with visitors
10. Assist in assessing and collecting fees and charges
11. Determine land use capability
12. Maintain work maintenance records
13. Assist in development of resource conservation plans
14. Interpret maps, charts, and aerial photographs

Duty B: Applying Laws, Regulations, and Policies

1. Interpret game and wildlife laws
2. Interpret stream, cake, pond, and groundwater laws
3. Maintain permits, certificates, and licenses
4. Post facility directions and warnings
5. Post facility rules and regulations

Duty C: Performing Promotional Activities

1. Conduct a visitor's program and tour
2. Register visitors
3. Give information and directions in a variety of formal and informal settings
4. Implement environmental education programs
5. Identify recreational needs and interests of special individuals and groups
6. Lead or guide recreational activities
7. Stimulate interest and participation in recreational activities for special groups

Duty H: Applying Safety Practices

1. Participate in safety training programs
2. Implement plans to protect visitors from dangerous animals and other hazards
3. Implement plans to protect animals and plants and other resources from visitors
4. Monitor equipment for safe operation
5. Complete accident or injury reports
6. Maintain shields, guards, and other safety devices on tools and equipment
7. Comply with safety requirements for working around automated equipment

STATE GOALS FOR LEARNING

In planning the instruction for this problem area, teachers can promote the development of several student learning objectives which are related to the State Goals for Learning in Biological and Physical Sciences and Social Sciences. These objectives are listed on the Learning Assessment Plan forms included on the following page(s). Those learning objectives marked with an asterisk (*) are taken from the sample lists provided by the Illinois State Board of Education.

CORE

Illinois Agricultural Core Curriculum

Agricultural Education 124 Mumford Hall 1301 W. Gregory Drive University of Illinois Urbana, IL 61801

Director: Dale A. Law, Ed.D.
Principal Investigator: Jerry D. Pepple, Ed.D
Research Assistant: Robert E. Petrea

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

Submission Date ____________________
☐ Original submission ☐ Revision
Page ____ of ____

I. LEARNING AREA *(check one)*
☐ Language Arts ☐ Fine Arts
☐ Mathematics ☐ Social Sciences
☒ Sciences ☐ Physical Development/Health

(Affix label or complete district information.)
COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐
District Name
City

II. STATE GOAL FOR LEARNING
As a result of their schooling, students will have a working knowledge of the concepts and basic vocabulary of biological, physical, and environmental sciences and their application to life and work in contemporary technological society.

Contact Person: ____________________
Title: ____________________
Phone: ( )

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Identify the components necessary for a community to exist and survive.					
*2. Compare a population growth curve to available natural resources.					
3. Define terms integral to managing hunting and fishing clubs.					
4. Describe the effects of wildlife habitat on the success of a hunting and fishing club.					
753					
					754

ISBE 41-78 (1/88)

Submission Date ____________
☐ **Original submission** ☐ **Revision**
Page ____ of ____

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

(Affix label or complete district information.)

COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐

District Name

City

I. LEARNING AREA *(check one)*

☐ Language Arts
☐ Mathematics
☐ Sciences
☐ Fine Arts
☒ Social Sciences
☐ Physical Development/Health

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will be able to apply the skills and knowledge gained in the social sciences to decision making in life situations.

Contact Person: ____________
Title: ____________
Phone: (   )   .

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Understand the knowledge and skills required for success in selected fields of work.					
*2. Recognize that competence in a field of work entails the development of a wide range of skills.					
3. Describe the various types of hunting and fishing clubs.					
4. Describe the characteristics of successful hunting and fishing.					

ISBE 41-79 (1/88)

Managing Hunting and Fishing Clubs

Illinois Agricultural Core Curriculum Rev.

Agricultural Resources
Outdoor Recreation

Submission Date ________________

☐ Original submission ☐ Revision

Page ____ of ____

I. LEARNING AREA *(check one)*

☐ Language Arts ☐ Fine Arts

☐ Mathematics ☒ Social Sciences

☐ Sciences ☐ Physical Development/Health

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

(Affix label or complete district information.)

COUNTY	DISTRICT	ESC

District Name

City

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will be able to demonstrate a knowledge of world geography with emphasis on the United States.

Contact Person: ________________

Title: ________________

Phone: (   )

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Analyze why similar habitats are used differently.					
*2. Know the relative importance of political, economic, and social attitudes which influence the use of the natural environment.					
3. Describe the characteristics of successful hunting and fishing clubs.					
4. Summarize the similarities and differences of hunting clubs and fishing clubs.					
757					758

ISBE 41-78 (1/88)

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Outdoor Recreation

PROBLEM AREA: Managing Hunting and Fishing Clubs

STUDENT LEARNING OBJECTIVES

Upon completion of their study of this problem area, students will be able to:

1. Define terms integral to managing hunting and fishing clubs.
2. Describe the various types of hunting and fishing clubs.
3. Describe the characteristics of successful hunting and fishing clubs.
4. Outline licensing requirements of hunting and fishing clubs.
5. Describe the effects of wildlife habitat on the success of hunting and fishing clubs.
6. Summarize the similarities and differences of hunting clubs and fishing clubs.

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Outdoor Recreation

PROBLEM AREA: Managing Hunting and Fishing Clubs

PROBLEMS AND QUESTIONS FOR STUDY

1. What are hunting clubs?
2. What are fishing clubs?
3. What are the different types of hunting and fishing clubs?
4. How are commercial clubs different from non-commercial clubs?
5. What are the differences between private and daily-fee clubs?
6. What elements are important to the success of a hunting or fishing club?
7. What licenses are required to operate a fishing club?
8. What licenses are required to operate a hunting club?
9. How do urban clubs differ from rural clubs?
10. How is a hunting or fishing club different from a game preserve?
11. What habitat maintenance considerations are important to hunting and fishing clubs?
12. How does maintenance of habitats affect the success of a hunting or fishing club?
13. What are the various methods of assessing fees at hunting and fishing clubs?
14. How can a hunting or fishing club be utilized in the off-season?

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Outdoor Recreation

PROBLEM AREA: Managing Hunting and Fishing Clubs

SUGGESTED TEACHING ACTIVITIES AND PROCEDURES

1. Use personnel from the Illinois State Department of Conservation (IDOC), the Cooperative Extension Service, and local sportsmen clubs as resources for specific information.

2. Use Unit D, "Basic Agribusiness Principles and Skills" from the Central Core Cluster for information on basic economic principles and basic business organization applicable to managing hunting and fishing clubs.

3. Use Unit A, "Agribusiness Operation and Management" in the Agricultural Business and Management Cluster for specific information and principles on managerial aspects associated with operating and managing hunting and fishing clubs.

4. Use the problem area, *Controlling Wildlife Pests*, for information on predators, nuisances, and pests that are of concern in managing hunting and fishing clubs.

5. Use the problem area, *Practicing Hunting Safety*, for information on safe hunting practices associated with hunting clubs.

6. Use the problem areas, *Maintaining Wildlife Habitats*, *Managing Game Preserves*, and *Managing Fish*, for information of habitat surveys and maintenance, population concerns and carrying capacity, and habitat preferences of specific wildlife species integral to managing hunting and fishing clubs.

7. Use the problem areas, *Managing Fish* and *Raising Game Birds and Animals* for information related to specific concerns in managing the target species of hunting and fishing clubs.

8. Use the problem areas, *Stocking Fish* and *Raising Game Birds and Animals*, for initial permits required to hold and raise fish and wildlife common to hunting and fishing clubs.

9. Invite members from local sportsmen clubs, hunting preserves, or fee fishing areas, to make a presentation to the class on the organization of their club, membership dues and requirements, activities, and maintenance and improvement strategies for the club grounds and wildlife habitat.

10. Plan a field trip to one of the game preserves listed on Information Sheet #5 or one of the fee fishing areas listed on Information Sheet #11. Areas of interest should include organization type, location, volume of business, marketing strategies, area that business is drawn from, method of pricing, off-season activities, expertise offered, habitat maintenance schedule, population concerns and strategies, and management (full-time, part-time, member sharing, etc.).

11. Use Information Sheets #3 and #4 as an extension of the wild game and bird breeder permit found in the problem area, *Raising Game Birds and Animals*. Lead the class in a discussion of the applicability of one permit to the other and the statutes applying to each.

12. Use Information Sheets #9 and #10 as an extension of the Aquaculture Permit found in the problem area, *Stocking Fish*. Lead the class in a discussion of the applicability of one permit to the other and the statutes applying to each.

13. Use Information Sheets #2, #6, and #8 for licensing requirements for hunting and fishing that would be of concern in managing hunting or fishing clubs. Actual hunting dates for the individual species vary from year to year and individual impoundments have site-specific regulations. Obtain current editions of IDOC publications "Guide to Public Hunting Areas in Illinois" and "Guide to Illinois Fishing Regulations" for use as student references.

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Outdoor Recreation

PROBLEM AREA: Managing Hunting and Fishing Clubs

REFERENCES

*1. *Hunting Preserves for Sport or Profit.* (1987). Kozicky, E. L. Caesar Kleberg Wildlife Research Institute, Campus Boy 218, Texas A & I University, Kingsville, TX 78363.

2. *Illinois Department of Conservation.* (Various publications). Information and Education, Lincoln Towers, Suite 100, 524 S. Second St., Springfield, IL 62706. (217) 782-7454.

3. *Guidelines for Developing a Fee Fishing Area.* Hutchins, B.W., Van Meter, J.R. Cooperative Extension Service #ORPR - 10. Available from the state library through the interlibrary loan service.

*Indicates highly recommended reference

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTIONAL RESOURCES

These resources are intended for use by teachers in planning and teaching the materials for this problem area and may be adapted to fit the teaching method(s) used.

INFORMATION SHEET #1 — Department of Conservation Regions

INFORMATION SHEET #2 — Hunting Licenses and Stamps

INFORMATION SHEET #3 — Game Breeding and Hunting Preserve Area Permit Application

INFORMATION SHEET #4 — Game Breeding and Hunting Preserve Area Permits

INFORMATION SHEET #5 — Illinois Hunting Preserves Open to the Public, 1989-90

INFORMATION SHEET #6 — Sport Fishing License

INFORMATION SHEET #7 — Publications on Fishing and Fisheries Management Available from the Department of Conservation Division of Fisheries

INFORMATION SHEET #8 — Statewide Sport Fishing Regulations

INFORMATION SHEET #9 — Fee Fishing Area License Application

INFORMATION SHEET #10 — Permits

INFORMATION SHEET #11 — Fee Fishing Areas, 1989

INFORMATION SHEET #12 — Bobwhite Quail

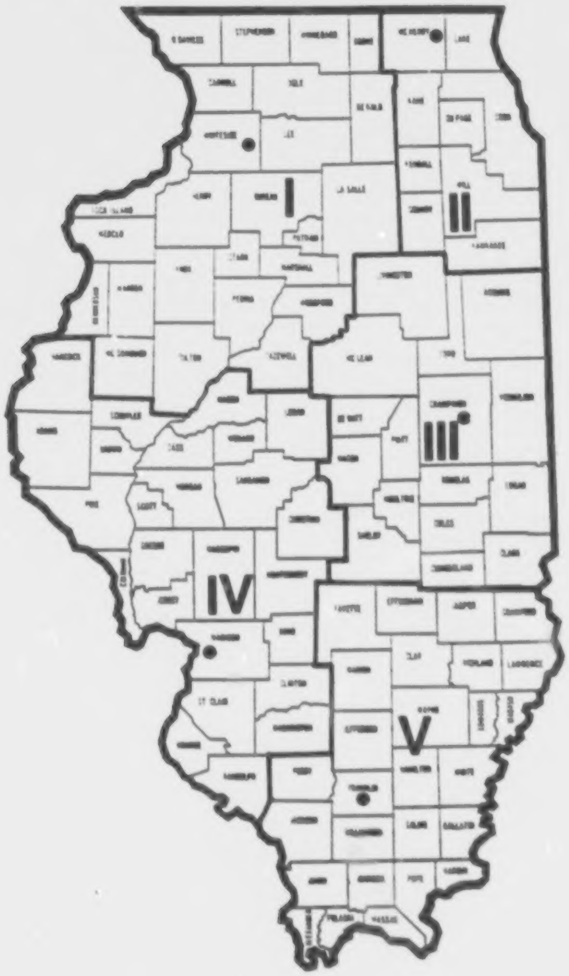
INFORMATION SHEET #13 — Factors that Make a Fee Fishing Area Successful

TRANSPARENCY MASTER #1 — Types of Hunting and Fishing Organizations (with discussion guide)

TRANSPARENCY MASTER #2 — Locations of Hunting and Fishing Organizations (with discussion guide)

INFORMATION SHEET #1

Department of Conservation Regions



For further information contact:

Region I - Sterling	(815) 625-2968
Region II - Spring Grove	(815) 675-2385
Region III - Champaign	(217) 333-5773
Region IV - Alton	(618) 462-1181
Region V - Benton	(618) 435-8138
Chicago Office	(312) 917-2070
Springfield Office	(217) 782-6384

INFORMATION SHEET #2

Hunting Licenses and Stamps

Hunters and trappers must have a current, valid license in their possession at all times when afield. Hunters 16 years of age and older need a Federal and State Migratory Waterfowl Hunting Stamp in their possession before hunting migratory waterfowl. The Federal Stamp must be signed in ink across the face. Illinois residents exempt from the purchase of a hunting license or State Migratory Waterfowl Stamp include:

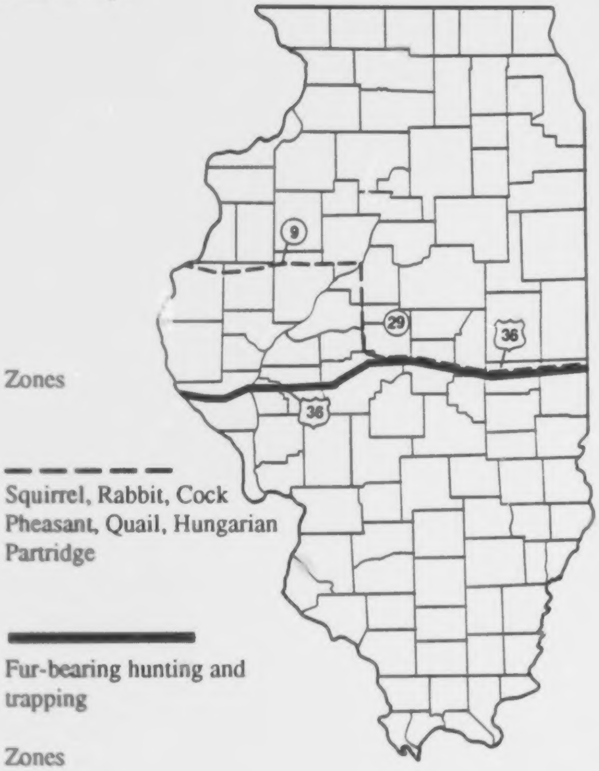
- Persons 65 years or older, physically disabled, or on leave from the U.S. Armed Forces (entering the military from Illinois); or
- Owners or tenants and their immediate families who reside and hunt on their land.

To purchase a hunting license a person under 16 needs (a) the written consent of a parent or guardian, plus a hunter safety certificate, or (b) proof of a previous hunting license.

Annual fees are (including agent's fees):

Resident hunting license	$ 7.50
Non-resident hunting license	Reciprocal (minimum is $15.75)
Resident trapping license	$10.50
State Migratory Stamp	$ 5.50
Federal Migratory Stamp (Available at U.S. Post Offices)	$12.50
Sportsmen's License (Combined Hunting and Fishing License)	$13.75

All licenses are valid from April 1 to March 31 of each year.


9
29
36
36
Zones
Squirrel, Rabbit, Cock Pheasant, Quail, Hungarian Partridge
Fur-bearing hunting and trapping
Zones

Squirrel (Cock Pheasant, Quail, Hungarian Partridge, Rabbit): Divided by Rt. 36 from the Indiana state line to Springfield, Rt. 29 from Springfield to Pekin, and Rt. 9 from Pekin to Dallas City, then due west to the Mississippi River.

Fur-bearing hunting (Coyote, Striped Skunk, Goundhog, Raccoon, Opossum, Red Fox, Gray Fox) and trapping: Divided by Rt. 36.

Illinois Department of Conservation

INFORMATION SHEET #3

Illinois
Department of
Conservation
life and land together

GAME BREEDING AND HUNTING PRESERVE AREA PERMIT APPLICATION
FEE $100.00

Name of Applicant or Organization ____________________

____

If applicant is an assocociation, club or corporation, the names and addresses of it's principal officers ____________________

____

____

____

Location of Area (Direction and distance from nearest town) ____________________

____

County in which Area is located ____________________

Number of contiguous acres in Area ____________________
(Attach the legal description of Area on back.)

Approximate numbers and species of game birds which will be released on the Area:

Pheasant ____________
Bobwhite Quail ____________
Coturnix Quail ____________
Hungarian Partridge ____________

Chukar Partridge ____________
Wild Turkeys ____________
Mallard Ducks ____________

Applicant's Signature ____________________ Title ____________

I DECLARE UNDER PENALTY OF PERJURY THAT THE ABOVE STATEMENTS ARE TRUE AND ACCURATE, AND HEREBY AUTHORIZE D.O.C. MAKE FURTHER INQUIRIES TO VERIFY THESE STATEMENTS.

Address ____________________

Telephone: Home ____________ Business ____________

Make check or money order payable to the Department of Conservation (Do not send cash) and mail to:

IL DEPARTMENT OF CONSERVATION
Wildlife Resources-Game Breeding & Hunting Preserve
P. O. Box 19225
Springfield, IL 62792-9225

THIS APPLICATION MUST BE FILED WITH THE DEPARTMENT PRIOR TO JULY 1.

Subscribed and sworn before me, this ____ day of ____________ A.D. 19___

____
Notary Public

This application is made subject to the provisions of Sections 3.27 through 3.35 of Chapter 61, IL Revised Statues and is subject to the approval of the Director of the Department of Conservation. The information requested on this form is necessary to accomplish the purpose under that Chapter. Disclosure of this information is voluntary however failure to comply may result in the rejection of this application.

The Department of Conservation does not discriminate on the basis of race, color, sex, national origin, age, or handicap in admission to, or treatment or employment in programs or activities in compliance with the Illinois Human Rights Act, the Illinois Constitution, Title VI of the 1964 Civil Rights Act, Section 504 of the Rehabilitation Act of 1973 as amended, and the U.S. Constitution. The Equal Employment Opportunity Officer is responsible for compliance and may be reached at 217-782-7616.

INFORMATION SHEET #4

Game Breeding and Hunting Preserve Area Permits*

Sec. 3.27. Any person owning, holding or controlling, by lease, which possession must be for a term of five or more years, any contiguous tract of land having an area of not less than 200 acres, and not more than 1,280 acres, with at least 100 acres of suitable wildlife habitat, who desires to establish a game breeding and hunting preserve area, to propagate, preserve and hunt game birds shall make application to the Department for a license as herein provided. Such application shall be made under oath of the applicant or under oath of one of its principal officers if the applicant is an association, club or corporation. In the case of releasing and harvesting hand reared mallards, the tract of land, with the approval of the Department, may be smaller than that required in this Section but in all other respects the applicant shall conform to the provision of this Act. The application shall be accompanied by a license fee of not to exceed $100.

Every licensee under this Section shall release not less than 250 Bobwhite quail or pheasants each season.

Upon receipt of such application, the Department shall inspect the proposed licensed area described in such application and the premises and facilities where game birds are to be propagated and the cover for game birds and the ability of the applicant to operate a property of this character. If the Department finds that the area meets the requirements of all applicable laws and administrative orders and that the game birds are reasonably healthy and disease free; and that the issuing of the license will otherwise be in the public interest; the Department shall approve the application and issue the license for the operation of the property described in the application with the rights and subject to the limitations in this Act prescribed.

All game breeding and hunting preserve area licenses expire on April 30 of each year.

Upon receipt of such license, the licensee shall promptly post such licensed areas at intervals of not more than 500 feet with signs to be prescribed by the Department. The boundaries of such licensed game breeding and hunting preserve areas shall also be clearly defined by natural or artificial boundaries and by signs.

Sec. 3.28. The license of any licensed game breeding and hunting preserve area may take, or authorize to be taken, on licensed areas and within the season fixed and designated, and in such numbers as herein provided, the following: (a) 100 percent of each of the following species of game birds released within the said season: hand reared pheasants, Bobwhite quail, Hungarian partridges, Chukar partridges, Coturnix and wild turkeys and (b) hand reared mallard ducks may be released at any time of the year for shooting purposes and 100 percent of those released may be harvested by shooting.

All the foregoing birds so released, except Coturnix, shall be at least 16 weeks of age before releasing the same and shall possess full plumage.

Sec. 3.29. For the purpose of this Act, game birds shall be released upon licensed game breeding and hunting preserve areas in a manner satisfactory to the Department. The licensee shall keep a register which shall clearly show the number and kind of game birds released and propagated each year, the date of release, and also the number and kind of game birds taken, the date when taken and the disposition made of such game birds, and shall submit such reports under oath as to game birds released, propagated and taken, to the Department not later than ten days following the end of each month during the season. The Department shall keep an adequate record of the number of birds released and propagated on each licensed game breeding and hunting preserve area in each year and of the birds taken.

The Department shall prepare special tags suitable for use upon legs of game birds, including hand reared mallard ducks, which tags shall be of a type not removable without breaking and mutilating the tag, such tags to be used to designate birds taken upon a licensed game breeding and hunting preserve area, and such tag shall remain upon the leg of such game bird until such bird is finally prepared for consumption. Those licensed areas which dress game birds may affix the tag to the bag in which the dressed game bird is contained. Upon application and payment of a fee of ten cents for each such tag, the Department shall furnish licensees with such tags; provided that the Department shall not in any year furnish any licensee a number of tags in excess of the number of game birds which may lawfully be taken from such licensed area as hereinbefore provided. All game birds harvested on licensed areas are to be properly banded on the same day they are taken.

Sec. 3.30. Game birds may be taken upon a game breeding and hunting preserve area only during the period from September 1st to April 15th, or as otherwise determined by the Director through the issuance of an Administrative Order, of each year, both dates inclusive.

Before any person shall take or attempt to take game birds upon such licensed game breeding and hunting preserve areas, he shall first secure a hunting license in accordance with this Act.

Sec. 3.31. The Department may designate any operator of a license game breeding and hunting preserve area or any of his or its agents or employees as a special representative of the Department with power to enforce the game laws and to prevent trespassing upon such property; provided that no more than two special representatives may be appointed for each such preserve. Such special representative shall be subject to rules and regulations to be prescribed by the Department and shall serve without compensation from the Department.

Sec. 3.33. The Department may either refuse to issue or refuse to renew or may suspend or may revoke any game breeding and hunting preserve area license if the Department finds that such licensed area or the operator thereof is not complying or does not comply with the provisions of Section 3.35 of this Act, or that such property, or area is operated in violation of other provisions of this Act, or in an unlawful or illegal manner; however, the Department shall not refuse to issue, refuse to renew nor suspend or revoke any license for any of these causes, unless the licensee affected has been given at least 15 days notice, in writing, of the reasons for the action of the Department and an opportunity to appear before the Department or a representative thereof in opposition to the action of the Department. Upon the hearing of any such proceeding, the person designated by the Department to conduct the hearing may administer oaths and the Department may procure, by its subpoena, the attendance of witnesses and the production of relevant books and papers. The Circuit Court upon application either of the licensee affected, or of the Department, may, on order duly entered, require the attendance of witnesses and the production of relevant books and papers before the Department or its representative in any such hearing. Upon refusal or neglect to obey its order, the Court may compel obedience by proceedings for contempt of court.

Sec. 3.35. Any licensee, or any other person, who willfully and intentionally transfers or permits the transfer of the tags issued to the operator of one licensed game breeding and hunting preserve area to the operator of another licensed game breeding and hunting preserve area, or to any other person, or who affixes such tags to game birds not taken from a licensed game breeding and hunting preserve area or to game birds taken from any area other than the area for which such tags were issued, is guilty of a Class B misdemeanor.

*A portion of Illinois Department of Conservation state statutes applicable to preserve areas.

INFORMATION SHEET #5

Illinois Hunting Preserves Open to the Public, 1989-90

Season: September 1 - April 15 License: Resident Hunting or Special Non-Resident $5

1. City Farmer Shooting Preserve
Olen D. Johnson
R.R. 2, Box 11
Edwardsville, IL 62025
***P

2. Western Illinois Hunting Unlimited, Inc.
Larry B. Hanold
R.R. 4, Box 98
Mt. Sterling, IL 62353
(217) 289-3366
***P, Q, C

3. Land O'Sports Ranch Limited
Morris Stinebring, Manager
R.R. 1, Box 140
Smithboro, IL 62284
(618) 326-7196
***P, Q, C

4. Hickory Grove Hunt Club
LeRoy & Michael Wirth
R.R. 1
Wyanet, IL 61379
**P, Q, C, T, M

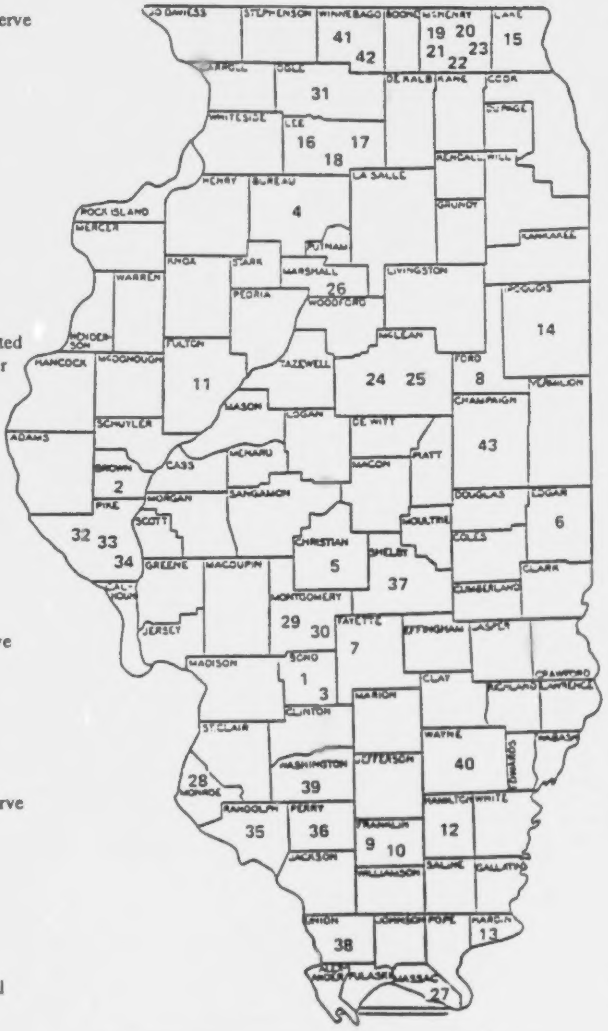
5. Pinkston's Hunting Preserve
Blaine Pinkston
28 Commercial Alley
Pana, IL 62557
(217) 562-5966
*P, Q, C

6. J & L Smith Hunting Preserve
James R. Smith
R.R. 3
Paris, IL 61944
(217) 465-6386
*** P, Q, C

7. Quail Hill
C. W. Johnson/Wayne Deal
P.O. Box 294
Vandalia, IL 62471
(618) 283-0772
***P, Q, C

8. Green Acres Sportsman's Club
Randall Sellek
R.R. 1
Roberts, IL 60962
(217) 395-2588
**P, Q, C, M

9. Wild Acres Quail Preserve
Orba Blades
R.R. 1, Box 68
Thompsonville, IL 62890
(618) 937-1548
*Q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JO DAVIESS
STEPHENSON
WINNEBAGO
BOONE
MCHENRY
LAKE
CARROLL
OGLE
DE KALB
KANE
COOK
WHITESIDE
LEE
DU PAGE
KENDALL
WILL
HENRY
BUREAU
LA SALLE
GRUNDY
ROCK ISLAND
MERCER
PUTNAM
KANKAKEE
WARREN
KNOX
STARK
MARSHALL
LIVINGSTON
PEORIA
WOODFORD
IROQUOIS
HENDERSON
HANCOCK
MCDONOUGH
FULTON
TAZEWELL
MCLEAN
FORD
VERMILION
MASON
LOGAN
DE WITT
CHAMPAIGN
ADAMS
SCHUYLER
CASS
MENARD
MACON
PIATT
BROWN
MORGAN
SANGAMON
DOUGLAS
EDGAR
PIKE
SCOTT
CHRISTIAN
MOULTRIE
COLES
SHELBY
GREENE
MACOUPIN
CLARK
CALHOUN
MONTGOMERY
CUMBERLAND
JERSEY
FAYETTE
EFFINGHAM
JASPER
MADISON
BOND
CRAWFORD
CLAY
RICHLAND
LAWRENCE
MARION
CLINTON
ST CLAIR
WAYNE
WABASH
MONROE
WASHINGTON
JEFFERSON
EDWARDS
RANDOLPH
PERRY
HAMILTON
WHITE
FRANKLIN
JACKSON
WILLIAMSON
SALINE
GALLATIN
UNION
JOHNSON
POPE
HARDIN
ALEXANDER
PULASKI
MASSAC

10. Frisco Game Preserve
M. Norris Webb
R.R. 1
Ewing, IL 62836
(618) 629-2527
*P, Q, C

11. Indian Ridge Hunting Club
Steve Clark, President
R.R. 3
Canton, IL 61520
(309) 647-1464
*P, Q

12. Knights Prairie Hunt Club
Jerry MacKenzie
R.R. 1, Box 142
McLeansboro, IL 62859
(618) 786-2690
***P, Q

13. The Shady Rest
Curtis O'Dell
Box 101
Cave-in-Rock, IL 62919
(618) 289-4323
***P, Q, C

14. Pinewood Hunting Club
Wayne DeYoung
R.R. 1, Box 36
Beaverville, IL 60912
(815) 435-2314
**P, Q, C, T

15. Gypsy Glen Farms Hunt Club
Peter C. Reiland
30808 North Darrell Road
McHenry, IL 60050
(815) 385-2144
**P, Q, C, M, T, H

16. Briar Knoll Hunting Club
F. L. Petitti, Secretary
629 Fourth Avenue
Dixon, IL 61021
(815) 284-6779
**P

17. Hidden Waters Sportsman Club
James Schulte
841 Todd Road
Ohio, IL 61349
(815) 376-4901
**P, Q

18. Roger's Hunting Club, Inc.
Roy & Roxie Rogers
R.R. 2
Ohio, IL 61349
(815) 379-2427
***P, Q, C

Key to the Directory

Game Birds:
P - Pheasants
Q - Quail
C - Chukar
H - Hungarian
T - Turkey
M - Mallard
Charges:
* Daily fee
** Membership only
*** Daily fee and membership

19. Huntley Game Farm
Rose B. Zerbal
10308 Crystal Lake Road
Huntley, IL 60142
(312) 669-5600
***P

20. Bull Valley Hunt Club
George Wold
916 N. Cold Spring Road
Woodstock, IL 60098
(815) 388-4240
**P, Q, C

21. McCullom Lake Hunt Club, Inc.
Jack Walsh, Treasurer
10603 Okeson Road
P.O. Box 303
Hebron, IL 60034
(815) 648-2775
**P

22. Richmond Hunting Club, Inc.
Charles F. Wonderlic
820 Frontage Road
Northfield, IL 60093
(815) 678-3271
***P, Q, M, C, T, H

23. Upland Bay Club
Ernest J. Varga
4218 Rt. 173
Richmond, IL 60071
(815) 678-4411
**P

24. Gunnerman Hunting Preserve
Bob Dewey
601 E. Cole
Heyworth, IL 61745
(309) 473-3114
*P, Q

25. Kraft's Hunting Preserve
Royce C. Kraft
R.R. 9, Box 17
Normal, IL 61761
(309) 728-2871
*P

26. Autumn Flight Game Fields
G. R. Holz
P.O. Box 135
Toluca, IL 61369
(815) 452-2004
**P, M

27. Feather Hill Farm Shooting Preserve
Kenneth S. & Janice L. Wiseman
R.R. 3
Metropolis, IL 62960
(618) 524-5463
*P, Q

28. Moredock Marsh Hunting Club
John H. Riechmann
R.R. 2, Box 163
Valmeyer, IL 62295
(618) 935-2518
**P, Q

29. Silver Spot Hunting Club
Don Cranfill
R.R. 2
Hillsboro, IL 62049
(217) 532-2797
***P, Q

30. Faller's Shooting Preserve
Donald T. Faller
R.R. 1
Butler, IL 62015
(217) 532-5287
**P, Q

31. Upland Hunt Club
Michael King
Davis Junction
Rockford, IL 61109
(815) 874-7444
***P, Q, C

32. Hopewell View Farms - Atlas
Rickard Wombles
R.R. 2
Rockport, IL 62370
(217) 734-9234
***P, Q, C, T

33. Hopewell View Farms - Summer Hill
Rickard Wombles
R.R. 2
Rockport, IL 62370
(217) 734-9234
***P, Q, C, T

34. North Pike Hunting Club, Inc.
Donavan Baldwin
R.R. 2
Griggsville, IL 62340
(217) 236-3131
*P, Q, C

35. Elm Shade Farm
Adolph Hitzemann
R.R. 2
Red Bud, IL 62278
(618) 282-2492
*P, Q, C

36. Streamline, Inc.
Ronald K. Doering, Secretary
P.O. Box 344
Percy, IL 62272
(618) 497-2775
***P, Q, C, M

37. Little Wabash Shooting Club
Gary L. Hartke
R.R. 2, Box 299A
Neoga, IL 62447
(217) 895-2267
*P, Q, C

38. Trail of Tears Sportsman's Club
Debra Charles, Secretary
R.R. 1
Jonesboro, IL 62952
(618) 833-6147
***P, Q, C, T

39. Heggemeier Hunting Club
Robert & David Heggemeier
R. R. 2
Nashville, IL 62263
(618) 327-2709
***P, Q, T, M, C

40. Covey Ridge
Charles Hazel
R.R. 1
Geff, IL 62842
(618) 854-2269
***P, Q

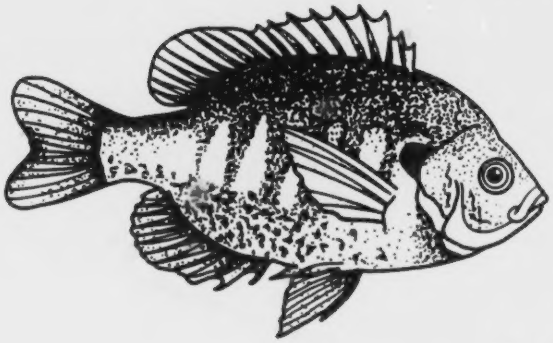
41. Argyle Hunt Club
Larry Humpal
1413 North Main Street
Rockford, IL 61103
(815) 962-1888
**P

42. Beacon Light Hunt Club
Jim McDonald
8304 Forest Preserve Road
Durand, IL 61024
(815) 629-2473
**P, C, H, T

43. Middlefork Valley Shooting Sports
C. E. Wilson, President
P.O. Box 8
Urbana, IL 61801
(217) 328-6666
***P, Q

INFORMATION SHEET #6

Sport Fishing License



Bluegill
(Illinois State Fish)

Illinois Residents:

A resident sport fishing license may be obtained by anyone who has been a resident of Illinois 30 days prior to purchase. Anglers under 16 years of age, 65 years or over, and persons declared legally disabled or blind, may fish without a license. Owners or tenants (if they reside on the land) may fish in waters on or flowing over their lands without a license. This exemption does not apply to club and organizational lakes or lake developments.

Persons on active duty in the Armed Forces are considered residents. A person on active duty in the Armed Forces, who entered the service from Illinois and is an Illinois resident, may fish without a license while on leave.

Non-Residents:

Non-residents of Illinois may purchase sport fishing licenses to fish waters of the state. Non-resident anglers under 16 years of age may fish without a license. All other non-resident anglers must purchase sport fishing licenses before fishing in Illinois (except in licensed fee fishing areas).

Resident or non-resident anglers who fish at fee fishing areas licensed by the Department of Conservation are not required to have a license.

Anglers must have their license in possession at all times while fishing. Licenses expire on March 31 each year. Current fees are (includes agent's fee):

Resident sport fishing; annual	$7.50
Resident sport fishing; 65 years old and over	None Needed
Resident sport fishing; under 16 years of age	None Needed
Resident sport fishing; disabled, blind	None Needed
Resident and non-resident sport fishing; 1 day, Lake Michigan only	$2.50
Non-resident sport fishing; 10 days	$8.50
Non-resident sport fishing; annual	$15.50
Sportsman License (combined hunting and fishing licenses)	$13.75
Salmon Stamp (licensed anglers only)	$2.50
Resident lifetime sport fishing	$210.00
Resident lifetime combined hunting and fishing license	$390.00

Illinois Department of Conservation

INFORMATION SHEET #7

Publications on Fishing and Fisheries Management
Available from the Department of Conservation Division of Fisheries

Fisheries Management:

1. "Management of Small Lakes and Ponds in Illinois"
2. "Aquatic Weeds — Their Identification and Methods of Control"

Areas to Fish:

3. "Recreational Areas Guide"

General Fishing:

4. "What Fish is This?"
5. "Guide to Eating Illinois Sport Fish"
6. "1990 Fishing Prospects"
7. "Recreational Areas Guide"
8. "Kids Fishing — It's Catching On"

Fishing Guides:

9. "Illinois Fishing Guide"
10. "Fishing Lake Michigan"
11. "Fox Chain O'Lakes Access Areas and Fishing Guide"
12. "Fox River Access Areas and Fishing Guide"
13. "Fishing the Kankakee and Iroquois"
14. "Fishing the Rock"
15. "Lake Shelbyville Fishing Guide"
16. "Carlyle Lake Fishing Guide"
17. "Rend Lake Fishing Guide"
18. "Fishing the Middle Mississippi"
19. "Fishing the Upper Mississippi"
20. "Fishing the Illinois"

The above publications may be obtained by writing to the:

Illinois Department of Conservation
Division of Fisheries
524 South 2nd Street
Springfield, Illinois 62706

INFORMATION SHEET #8

Statewide Sport Fishing Regulations

Fish or Frog	Statewide Catch and Size Limits
Black Bass (includes largemouth, smallmouth, and spotted bass)	6 fish daily (single or collectively); 12-inch minimum length limit in the Mississippi River between Illinois and Iowa
Pure Muskie and Tiger Muskie	1 fish daily (singly or collectively); 30-inch minimum length limit
Northern Pike	3 fish daily (except in Mississippi River between Illinois and Iowa where daily limit is 5 fish and in Mississippi River between Illinois and Missouri where the daily limit is 1 fish; 24-inch minimum length limit, except in Mississippi River where there is no size limit)
Salmon and Trout (in Lake Michigan)	5 fish daily (singly or collectively, not more than 3 of which may be Lake Trout); minimum length limit of 10 inches
Salmon and Trout (outside Lake Michigan)	5 fish daily (singly or collectively); Closed Seasons: Spring (March 15 to 1st Saturday in April) and/or Fall (October 1st to third Saturday in October). (See site regulations for specific areas.)
Striped Bass (includes Ocean Rockfish, White Bass, and their hybrids)	No bag limit for fish less than 17 inches, except in certain waters. Bag limit is 3 in all waters for fish 17 inches in total length or longer
Walleye and Sauger	6 fish daily (singly or collectively, except in the Mississippi River between Illinois and Iowa where the daily catch limit is 10 fish and in the Mississippi River between Illinois and Missouri where the daily limit is 8 fish)
Bullfrog (season June 15 - August 31, both dates inclusive)	8 frog daily limit with 16 possession limit

These are statewide regulations; specific water areas may have regulations which differ and are more restrictive. **Please check the SITE-SPECIFIC REGULATIONS which are posted (at boat launches and at site offices) at each water area where applicable.**

Illinois Department of Conservation

INFORMATION SHEET #9

Illinois Department of Conservation
life and land together

FEE FISHING AREA LICENSE APPLICATION

Any person owning, controlling or operating, a water area including access to this water area, that is used for fishing by those either directly or indirectly paying a fee for such purposes shall make application to the Department for a Fee Fishing Area License.

THE FEE FOR A FEE FISHING AREA LICENSE SHALL BE $50 ANNUALLY, AND SUCH LICENSE SHALL EXPIRE ON JANUARY 31 OF EACH YEAR.

Nearest town to location ____________________ Number of Ponds __________

Acreage of each pond ____________________

Maximum depth of each pond ____________________

Species of fish present ____________________

Where were fish obtained? ____________________

How often is pond stocked? ____________________

Fees collected in order that pond may be fished:

	Please Check	Amount		Please Check	Amount
Trespassing			Per Person		
Per Pole			Per Use of Boat		
Per Fish			Per Boat Launching		
Per Pound of Fish			Other ______		
Per Hour					

FOR OFFICE USE ONLY

APPROVED ____ DISAPPROVED ____

Signature of Inspecting Biologist ____________________

LAST NAME ☐☐☐☐☐☐☐☐☐☐☐☐☐☐

FIRST NAME ☐☐☐☐☐☐☐☐☐☐☐

BUSINESS NAME ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

STREET ADDRESS OR R.R. & BOX NUMBER ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

CITY ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐ STATE ☐☐ ZIP CODE ☐☐☐☐☐

COUNTY OF RESIDENCE ☐☐☐☐☐☐☐☐☐☐☐☐

______________________ DAYTIME TELEPHONE NUMBER ____ ____-____
APPLICANT'S SIGNATURE

I DECLARE UNDER PENALTY OF PURJURY THAT THE ABOVE STATEMENTS ARE TRUE AND ACCURATE AND HEREBY AUTHORIZE D.O.C. TO MAKE FURTHER INQUIRIES TO VERIFY THESE STATEMENTS.

You must enclose a check or money order with this application. **Do not send cash.**

MAIL APPLICATION AND FEE TO:

ILLINOIS DEPARTMENT OF CONSERVATION
COMMERCIAL LICENSE/PERMIT
524 SOUTH SECOND, ROOM 210
P.O. BOX 19458
SPRINGFIELD, ILLINOIS 62794-9458

Please call (217) 785-3423 if you have any questions.

This information requested in this form is necessary to accomplish the statutory purpose under Chapter 56, IL Revised Statutes. Disclosure of this information is voluntary, however failure to comply may result in this application being rejected. This form has been approved by the State Forms Management Center.

The Illinois Department of Conservation receives Federal financial assistance and therefore must comply with the federal anti-discrimination laws. In compliance with the Illinois Human Rights Act, the Illinois Constitution, Title VI of the 1964 Civil Rights Act, Section 504 of the Rehabilitation Act of 1973 as amended, and the U.S. Constitution. The Illinois Department of Conservation does not discriminate on the basis of race, color, sex, national origin, age, or disability. If you believe you have been discriminated against in any program, activity, or facility please contact the Equal Employment Opportunity Officer, Department of Conservation, 524 S. Second St., Springfield, IL 62701-1787, 217/782-7616 or the Office of Human Resources, U.S. Fish & Wildlife Service, Washington, D.C. 20240.

IL 422-0725

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INFORMATION SHEET #10

Permits*

5.17. Owners of water areas - license required

Any person owning, controlling or operating a water area including access to this water area, that is used for fishing by those either directly or indirectly paying a fee for such purposes shall make application to the Department for a license as herein provided. Upon receipt of such application, the Department shall inspect the proposed licensed area described in such application, the size and number of water areas, source of fish for stocking, and species of fish to be stocked, and determine the ability of the applicant to properly supervise a property of this character. If the Department finds that the area is suitable for the purpose intended and that the operation of such property is not a menace, or being established contrary to the laws of this State and that the operations of such fee fishing area will not work a fraud upon persons utilizing the facilities thereon, and that the issuing of the license will be in the public interest, the Department shall approve such application and issue a license to operate a "Fee Fishing Area" as described in the application.

The fee for a license issued under the provisions of this Section shall be $50 annually, and such license shall expire on January 31 of each year.

Records of the season's operations, as may be required by the Department, shall be forwarded to the Department by the licensee within 30 days after the expiration date of the license.

The Department may either refuse to issue, refuse to renew, may suspend or may revoke any license issued under the provisions of this Section if the Department finds that such licensed area or the operator thereof is not in compliance with the provisions of this Section; however, the Department shall not refuse to issue or renew or suspend or revoke any license for any cause other than the protection of public health and safety or if the area is operated unlawfully, unless the licensee affected is given at least 15 days notice, in writing, of the reasons for the action of the Department and given an opportunity to appear before the Department or a representative thereof in opposition to the action of the Department.

(Amended by P.A. 81-383, #1, eff. Jan. 1, 1980; P.A. 85-151, #1, eff. Jan. 1, 1988.)

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* A portion of Illinois Department of Conservation state statutes concerned with fee fishing areas.

INFORMATION SHEET #11

Fee Fishing Areas, 1989

Midwest Charter Association, Inc.
2816 N. Lincoln Avenue
Chicago, IL 60657
(312) 327-8872

Waukegan Charter Boat Association
Box 946
Waukegan, IL 60657
(708) 244-3474

Chicago Sportfishing Association
25 E. Washington, Suite 823
Chicago, IL 60602
(312) 922-1100

Wilderness Acres
Rt. 4, Box 55
Highland Park Rd.
Danville, IL 61832

Wayne Adams
Rt. 3, Box 196A
Thompsonville, IL 62890

James Atchley
Rt. 1, Box 270
Lewistown, IL 61542

Fish Lake Beach, Inc.
32223 N. Hwy. 12
Round Lake, IL 60073

Paul Booth, Sr.
1204 Jericho Rd.
Aurora, IL 60506

Sharon Buchanan
Buchanans Twn. Lks. & Bait Shop
Rt. 8, Box 258
Staunton Rd.
Edwardsville, IL 62025

Mills Bur-Oaks, Inc.
Rt. 2, Box 87
Alhambra, IL 62001

Patricia Burgard
Rock Lake
Rt. 5 & Joliet Rd.
Lemont, IL 60439

Timberline Camp & Rec.
P.O. Box 92
Goodfield, IL 61742

Glen-Nell Campground
Rt. 1
St. Francisville, IL 62460

Indian Point Campground
Rt. 1
St. Augustine, IL 61474

Shady Lakes Campground
Rt. 1, Box 8
New Windsor, IL 61465

Tomahawk Campground
Rt. 1
Pocahontas, IL 62275

Lake Catatoga Association
P.O. Box 348
Carlinville, IL 62626

Williamson Christian Center Lake
Box 225
Carlinville, IL 62626

Harry E. Blements
Berlin Lake
Rt. 1
Pleasant Plains, IL 62677

Community Lake Campground Inc.
Box 29
Willisville, IL 62997

Hickory Lane Camping and Fishing
Rt. 2, Box 176
Atlanta, IL 61723

Carries Country Lane Lake
Rt. 4, Box 99
Charleston, IL 61920

Gerald Davis
S & L Fish Farm
Rt. 2, Box 83
Eldorado, IL 62930

Lincoln Deer Park/Campground
Rt. 97
Tallula, IL 62688

Andres Dock
Rt. 1, Box 80
Valmeyer, IL 62295

Don Doll
Rt. 1
Pocahontas, IL 62275

Andys Dream Lake
Rt. 1
Oakwood, IL 61858

Fishermans Dude Ranch
9665 Golf Rd.
Des Plaines, IL 60016

Steve Embrich, Sr.
Rt. 2, Box 218
Millstadt, IL 62260

Trappers Fall Fish/Fur
Rt. 1, Box 245A
Prairie Du Rocher, IL 62277

Dixon Fisheries
1807 N. Main St.
E. Peoria, IL 61611

Threws Fishing Area
Rt.
Farmington, IL 61531

Parkview Fishing Lake
Richard Henke
Rt. 2, Birch Dr.
E. Alton, IL 62024

Gene Vest Fishing Lakes
Rt. 7, Box 37
Marion, IL 62959

Barneys Fishing Lake
Rt. 1, Box 237
Tolono, IL 61880

Schmidts Fishing Ponds
17350 S. Cicero
Country Club Hills, IL 60477

Brandt Fishing Resort
Rt. 1, Box 380
Lockport, IL 60441

Plainfield Fishing Resort
741 E. Renwick Rd.
Plainfield, IL 60544

Eugene Gall
Woodlot Retreat
14609 Nelson Rd.
Woodstock, IL 60098

Giant Goose Ranch
Box 407
Kewanee, IL 61443

Dorothy Gordon
Gregs Lake
Rt. 3, Box 27B
Taylorville, IL 62568

Bluford Grain Co., Inc.
Rt. 2
Bluford, IL 62814

E. W. Haury
510 S. Chestnut
Sparta, IL 62286

Allen Hawk
Rt. 1, Box 56
Gorham, IL 62940

Willie Hill
Rt. 1, Box 205
Pleasant Hill, IL 62366

Hickory Hollow
604 N. Monroe
Abingdon, IL 61410

Bull Valley Hunt Club
916 N. Cold Spring Rd.
Woodstock, IL 60098

Delbert L. Jason
711 N. Prairie
Lacon, IL 61540

Lake Kaiser
1427 S. Clinton Rd.
Caseyville, IL 62232

Joe L. Kinnear
Little Ponderosa Catfish Farm
Rt. 2, Box 336
McLeansboro, IL 62859

Jim Krause, Sr.
267 Green Ct.
Wood Dale, IL 60191

Barths Lake
Rt. 1
Bunker Hill, IL 62014

Bucks Lake
Rt. 1
Fults, IL 62244

Cote Lake
Rt. 2, Box 77A
St. Anne, IL 60964

D & W Lake
Rt. 4, Box 82
Champaign, IL 61820

Daves Lake
Rt. 1, Box 33C
Glenarm, IL 62536

Fools Lake
Rt. 1, Box 278
Aledo, IL 61231

Goose Lake
Rt. 2, Box 182
Quincy, IL 62301

Haiers Lake
302 Elkton
Okawville, IL 62271

Kings Lake
Rt.
Mt. Olive, IL 62069

Lovalli Lake
5N741 Thorn Rd.
Roselle, IL 60172

Micks Lake
P.O. Box 385
Ereese, IL 62230

Pearl Lake
Hwy. 51
S. Beloit, IL 61080

Rod Andria Lake
Rt. 2
Coulterville, IL 62237

Sandy Lake
3145 Lake Dr.
Granite City, IL 62040

Shaus Lake
4038A Miami
St. Louis, MO 63116

Stuarts Lake
Laxman Alreja
1750 Buena Vista Dr.
Wheaton, IL 60187

Angies Silver Lake Bait Shop
Rt. 2, Box 23
Lebanon, IL 62254

Cedar Lakes
Rt. 1, Box 3
Coatsburg, IL 62325

Cottonwood Lakes
Rt. 1
Millstadt, IL 62260

Leisures Lakes
Rt. 1
Chatham, IL 62629

Midwest Lakes
Rt. 5, Box 325
Belleville, IL 62221

Pine Lakes Resort
Rt. 3, Box 103A
Pittsfield, IL 62363

Camp Lakewood
1217 W. Rickleman
Effingham, IL 62401

Sung Sik Lee
Springhaven
Rt. 1, Box 335B
Ashmore, IL 61912

Dennis Loveall
Rt. 3
Lincoln, IL 62656

Gypsy Glen Management Inc.
Peter C. Reiland
30808 N. Darrell Rd.
McHenry, IL 60050

Whispering Oaks Campground
Quad-Rell
Rt. 1
Mendon, IL 62351

Lake Pauline
1635 6th St.
Madison, IL 62060

Captains Pay Lake
Rt. 8, Box 169
Decatur, IL 62522

Everetts Peaceful Acres
375 N. 3rd St.
Albion, IL 62806

Little Ponderosa Campground
P.O. Box 75
Aledo, IL 61231

Brownings Ponds
Box 31
Olive Branch, IL 62969

Jim Powers
Five Corner Farm
18250 Beck Rd.
Marengo, IL 60152

Chillicothe Recreation Area Limited
P.O. Box 505
Chillicothe, IL 61523

Romeoville Recreation Dep.
900 W. Romeo Rd.
Romeoville, IL 60441

Coon Creek Resort
Larry Frey/Tom Roniger
Rt. 1, Box 10C
Highland, IL 62249

Biz's R V Sales/Campground
Rt. 94S
Carthage, IL 62321

Recreation Servs Branch
3345 ABG/SSRO/Stop 96
Chanute AFB, IL 61868

Lake Shepherd
Rt. 1
Morton, IL 61550

Tony Sveglich
Rt. 1, Box 12
Smithboro, IL 62284

Camp Sycamore
Box 15
Sycamore, IL 60178

Bails Timberline Lake
Box 241
St. Elmo, IL 62458

River View
RFD
Grand Chain, IL 62941

McGraw Wildlife
Box 9
Dundee, IL 60118

Jeff Yergler
Yergler-Lutticker Farms
3201 Sheridan Rd., Box 188
Pekin, IL 61554

O'Connels Yogi Bear Jell
P.O. Box 175
970 Greenwing Rd.
Amboy, IL 61310

INFORMATION SHEET #12

Bobwhite Quail

The production of Bobwhite Quail can provide part-time or full-time income for a limited number of producers. Quail can be marketed as a meat source or for hunting purposes.

Bobwhite Quail can be produced for meat production or for hunting purposes. The larger varieties are generally selected for meat production, while medium and small varieties are grown for hunting. The smaller varieties are generally faster and fly better and are in demand for use in hunting reserves.

Select breeding stock that has a history of good egg production, hatchability, and livability. Breeding stock should come from a disease-free source, preferably tested for and free of pullorum and typhoid. Birds or hatching eggs may be purchased for breeding stock.

Breeding stock can be kept in either cages or in floor pens. The advantage of cages is that eggs are kept cleaner and have less exposure to disease and parasites. Cages can be for an individual pair or a colony. Birds need about 0.5 square feet of space each. A solid partition between cages is needed to prevent fighting. Floor pens should provide one square foot of floor space per bird.

By providing up to 17 hours of light per day year-round, one can attain production. Bobwhite hens will begin egg production at 16 to 24 weeks of age. In a six-month breeding season, a hen will produce about 90 eggs.

Eggs should be stored at 55 degrees to 65 degrees F and at a relative humidity of 75 to 80 percent until incubation. Proper incubation procedures are as follows:

1. Period of incubation 23 to 24 days.
2. Temperature 99.75 degrees F.
3. Humidity, wet bulb 84 to 86 percent.
4. Future breeders should be debeaked at hatching.

After hatching the young birds should be brooded for five or six weeks. Several different types of facilities can be used including batteries, floor pens with litter, and raised wire floors. Less space is required if batteries or raised wire floors are used. However, a floor pen with a hover or infrared brooder is the simplest method.

Mixing of feed on the farm is possible, but purchasing commercially prepared feeds is generally more economical. A chick starter should be fed free-choice from one day of age to six weeks of age. A growing diet should be fed to birds 6 weeks of age to 16 weeks of age. Birds that will be used for hunting purposes should be fed a flight conditioner feed starting at six weeks of age. Birds raised for meat should be fed a finishing feed from 16 weeks of age until they reach a weight of 2.5 pounds. Clean, fresh water should be provided for birds at all times.

Quail seem to be more sensitive to mismanagement than chickens. Cannibalism is increased by crowding, bright lights, insufficient feeders and water space, too high temperatures, and placing different types of birds together. Most of the cannibalism can be controlled by proper management and debeaking. Future breeders should be debeaked at hatching.

Bobwhite Quail are susceptible to most of the diseases and parasites that affect domestic poultry. A disease prevention program similar to that of chickens should be used.

Bobwhite Quail can generally be marketed at 16 weeks of age or slightly older. At this age they can be used for meat or hunting purposes. Most producers of hunting birds condition the birds in wire pens 12 to 15 feet wide and 100 to 150 feet long for about one month before they are released. Many producers contract a year or two ahead for the sale of their birds.

Adapted from Louisiana Department of Education Bulletin #1806

INFORMATION SHEET #13

Factors that Make a Fee Fishing Area Successful

The shortage of fishing waters has sparked a demand for fee fishing areas. Fisherman are willing to pay for the opportunity to catch fish near their home. By eliminating the travel and lodging costs of a fishing trip, they find it costs less to "fee" fish.

The following factors appear to be basic for operating a successful fee fishing area:

1. Location — The area should be within ten miles of a city of 10,000 or within 25 miles of a city of 50,000 or more people. The area should be well marked by signs and be easy to reach.
2. Suitable ponds — Several ponds should be available, with a good water supply which can be drained and yet be ten feet or more in depth and from one-half to ten acres in size. With several ponds, a variety of fish can be stocked.
3. Source of fish — A source of catchable-size fish is needed for restocking as the supply is reduced. A number of reliable wholesale fish dealers operate in Illinois.
4. Additional facilities — Almost 40 percent of the gross income is from the retail sale of tackle and bait, food, and beverages. Conveniences usually offered include seats and benches for fishermen, picnic tables, drinking water, shade, and restrooms.
5. Proper charges — Charges may be on a daily basis per pole or for the pounds or number of fish caught. Regardless of the method used, accurate records of the income must be kept, and the price should be based on the cost of operation plus a profit.
6. Lack of competition — Competition with similar types of fishing operations would be undesirable.

Types of Fish Stocked

The two types of fishing operations common in Illinois are those stocked with trout, and the carp-catfish-bullhead lakes. A large spring flowing into the pond which will keep the water temperature about 65 degrees is preferred for a trout lake. Those who stock with warm-water species find that channel catfish, carp, and bullheads provide the best fishing.

There is a relationship between the oxygen supply and the number of fish that can be stocked. Trout require more oxygen than catfish and carp, but spring-fed lakes may not get as low in oxygen during hot weather as lakes supplied by surface-water drainage.

Sale of Bait and Worms

Carp prefer worms in the spring, but doughballs are more popular as bait from June on. Almost every fee-fishing area sells both doughballs and worms as a sideline income.

The mixture used for doughballs differs slightly with each operator and the formula is highly secret. Some doughballs are packaged in plastic bags to keep them fresh. Others are sold in paper cups. An eight-ounce package generally sells for 25 to 35 cents.

The main ingredients are a corn cereal, alfalfa meal, white corn meal, and lots of salt. Other ingredients that may be added are cottonseed meal, wheat middlings, wheat germ, dried molasses, oatmeal, and garlic. Some doughballs are light-colored and some are dark. The light-colored bait is more popular. The dark color is from the alfalfa meal.

Worms may be sold without packaging or they may be put in cartons with bedding, which adds 10 cents per dozen to the cost. About half of the income is profit, unless the worms die or crawl away or there is a shortage on the count.

Adapted from Cooperative Extension Service #ORPR - 10.

TRANSPARENCY MASTER #1

Types of Hunting and Fishing Organizations

Commercial:

Daily Fee

Private

Non-Commercial:

Private

Co-op

Do-it-yourself

TRANSPARENCY MASTER #2

Locations of Hunting and Fishing Organizations

1. Urban

2. Rural

TRANSPARENCY MASTER DISCUSSION GUIDE

Transparency Master #1

Commercial organizations have the aim of providing a profit for those operating them. A commercial venture may be open to the public on a fee basis, such as a hunting preserve that charges on the number of birds released or the number of birds taken or a fee fishing area that charges by the pound of fish caught. Other examples would be a charter operation on Lake Michigan that charges hourly or daily fees or a guide service on one of the many Illinois lakes.

Private commercial operations assess membership dues. These dues may be a percentage of total operating expenses or may be a basic fee that permits only access to the facility, with other fees assessed on the individual's use. An example would be a hunting club in which members make a financial commitment for so many birds in the spring for fall hunting and it is the members' responsibility to use the birds. Many private preserves and clubs began as daily fee operations and were then converted, as an increasing number of satisfied customers provided the capital required for the many expenses incurred.

Non-commercial operations may be private, co-op, or do-it-yourself. Private non-commercial operations are not-for-profit ventures and may be operated by individuals, corporations, or foundations. A manager is usually hired to run the facility to meet the objectives, usually altruistic in nature, of the operators.

Co-op and do-it-yourself clubs are represented by the many, usually rural, sportsmen clubs. The similarities of the two are many with the basic ingredient being sportsmen interested in the same specie(s). Differences occur in the rigidity of organization. Co-ops may be incorporated, have bylaws, elected officers, structured fees, hunting or fishing schedules, land purchase or rental, long-term habitat improvement projects, etc. Do-it-yourself operations are more loosely run with the interested parties simply sharing the expenses and work. Examples could be a group working at a specific site to improve the habitat and/or stocking fish or a group banding together to purchase and release birds for hunting or field trials.

Transparency Master #2

The location of a particular hunting or fishing club will influence the operation. A rural operation may have activity only during the target species season and may have few, if any, amenities such as food service or a clubhouse. Barrow pits remaining from interstate highway construction have been used for individual or club fishing activities such as swimming, habitat improvement, and fish stocking. Fee fishing operations have also made use of these sites.

An urban organization may be simply a fee fishing area using a barrow pit or constructed ponds, or it may be a commercial or private hunting preserve located within easy driving (an hour or so) of a metropolitan area. The expense of these facilities may lead to year-round activity.

Fishing areas may be located on impoundments within a preserve that provides recreation activities for the entire family. These other activities might include firing ranges, clay target shooting, nature trails, skiing, picknicking areas, swimming, ice skating, snowmobiling, hunter education courses, social events within the facilities, etc. All may be utilized within the off-seasons to provide income for facility maintenance.

Regardless of the location, and regardless of whether the organization is commercial or private, decisions necessary for perpetuation of the goals will have to be made. A manager hired to run a commercial club will need to consider:

Target species — Habitat needs, populations, legal or necessary limits, etc.

Information and expertise — Knowledge of species, hunting or fishing techniques, equipment, teaching customers or members.

Habitat — Needs of species, manipulative techniques, survey and assessment, carrying capacity.

Management — Pricing, equipment, financial records, legal aspects, insurance and liability, customer communications, goals.

Equipment — Supply commensurate with needs, rental to customers, require customers to supply.

Grounds and Facilities — Needs, appearance, maintenance, improvement.

If the club is a co-op or do-it-yourself, the scale of decisions may be smaller and the members may jointly make the decisions required and even share the work. However, the principal functions will still need to be performed.

STUDENT ACTIVITIES

STUDENT WORKSHEET #1 — Quail Questions

For additional activities, teachers may refer to the "Suggested Teaching Activities and Procedures" section in the Instructor's Guide.

STUDENT WORKSHEET #1

Quail Questions

Multiple Choice:

_______ 1. Bobwhite Quail breeding stock for meat production should be selected from varieties.

a. small
b. medium
c. large
d. faster

_______ 2. Caged quail need about _________ square feet per bird.

a. 0.5
b. 1
c. 1.5
d. 2.5

_______ 3. Young birds should be brooded after hatching for a period of __________.

a. 2 weeks
b. 6 weeks
c. 2 months
d. 6 months

_______ 4. Cannibalism in quail can be caused by:

a. crowding
b. bright lights
c. high temperatures
d. insufficient feeder space
e. a and d
f. all of the above

_______ 5. The advantage to cage production of quail is:

a. cleaner eggs
b. less exposure to parasites
c. less waste of feed
d. a and b
e. all of the above

STUDENT WORKSHEET #1 — Key

Quail Questions

Multiple Choice:

__c__ 1. Bobwhite Quail breeding stock for meat production should be selected from varieties.

a. small
b. medium
c. large
d. faster

__a__ 2. Caged quail need about ________ square feet per bird.

a. 0.5
b. 1
c. 1.5
d. 2.5

__b__ 3. Young birds should be brooded after hatching for a period of ________.

a. 2 weeks
b. 6 weeks
c. 2 months
d. 6 months

__f__ 4. Cannibalism in quail can be caused by:

a. crowding
b. bright lights
c. high temperatures
d. insufficient feeder space
e. a and d
f. all of the above

__d__ 5. The advantage to cage production of quail is:

a. cleaner eggs
b. less exposure to parasites
c. less waste of feed
d. a and b
e. all of the above

786

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Outdoor Recreation

PROBLEM AREA: Practicing Hunting Safety

RELATED PROBLEM AREAS:

1. Managing Game Preserves
2. Managing Hunting and Fishing
3. Controlling Wildlife Pests
4. Maintaining Wildlife Habitat
5. Conserving Wildlife Resources (Agricultural Business Management Cluster)

PREREQUISITE PROBLEM AREA(S): None

LEVEL: Orientation

OCCUPATIONAL TASKS ADDRESSED:

Duty B: Applying Laws, Regulations, and Policies

1. Interpret game and wildlife laws
2. Maintain permits, certificates, and licenses

Duty D: Managing Facility Flora and Fauna

1. Identify wildlife species within a selected area

Duty H: Applying Safety Practices

1. Participate in safety training programs
2. Store flammable and other hazardous materials safely
3. Monitor equipment for safe operation

STATE GOALS FOR LEARNING

In planning the instruction for this problem area, teachers can promote the development of several student learning objectives which are related to the State Goals for Learning in Social Sciences. These objectives are listed on the Learning Assessment Plan forms included on the following page(s). Those learning objectives marked with an asterisk (*) are taken from the sample lists provided by the Illinois State Board of Education.

Illinois Agricultural Core Curriculum

Agricultural Education 124 Mumford Hall 1301 W. Gregory Drive University of Illinois Urbana, IL 61801

Director: Dale A. Law, Ed.D.
Principal Investigator: Jerry D. Pepple, Ed.D
Research Assistant: Robert E. Petrea

Illinois Agricultural Core Curriculum Rev.

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

Submission Date ____________
☐ Original submission ☐ Revision
Page ____ of ____

(Affix label or complete district information.)

COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐

District Name

City

Contact Person: ____________
Title: ____________
Phone: ( )

I. LEARNING AREA *(check one)*

☐ Language Arts
☐ Mathematics
☐ Sciences
☐ Fine Arts
☒ Social Sciences
☐ Physical Development/Health

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will be able to apply the skills and knowledge gained in the social sciences to decision making in life situations.

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Understand the knowledge and skills required for success in selected fields of work.					
*2. Recognize that competence in a field of work entails the development of a wide range of skills.					
3. Name the parts common to firearms and state their function.					
4. Explain the dynamics of bullet propulsion.					
789					790

ISBE 41-78 (1/88)

Practicing Hunting Safety

Agricultural Resources
Outdoor Recreation

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Outdoor Recreation

PROBLEM AREA: Practicing Hunting Safety

STUDENT LEARNING OBJECTIVES

Upon completion of their study of this problem area, students will be able to:

1. Define terms integral to practicing hunting safety.
2. Name the parts common to firearms and state their function.
3. Explain the dynamics of bullet propulsion.
4. Describe the regulations concerning firearm ownership and hunter education.
5. Give examples of the major causes of hunting accidents and explain prevention techniques.
6. Recognize safe hunting practices.

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Outdoor Recreation

PROBLEM AREA: Practicing Hunting Safety

PROBLEMS AND QUESTIONS FOR STUDY **INSTRUCTOR'S NOTES AND REFERENCES**

1. What are the parts of a rifle?
2. What are the parts of a shotgun?
3. What are the parts of a handgun?
4. How are the operations of a rifle, shotgun, and handgun similar?
5. How do the operations of a rifle, shotgun, and handgun differ?
6. What are the parts of a firearm cartridge?
7. What are the parts of a shotgun shell?
8. How does a cartridge fire?
9. What are the physics and chemistry principles involved in the firing of a cartridge?
10. What are the state regulations for owning a firearm?
11. What are requirements for hunter education?
12. Why is it important for hunters to be educated?
13. What are the major causes of hunting accidents?
14. Why do hunting accidents happen?
15. How can hunting accidents be prevented?
16. What are some examples of safe hunting practices?
17. Why is it important to prevent hunting accidents?

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Outdoor Recreation

PROBLEM AREA: Practicing Hunting Safety

SUGGESTED TEACHING ACTIVITIES AND PROCEDURES

1. Use personnel from the Illinois Department of Conservation Law Enforcement Division, the National Rifle Association Education and Training Division, local sportsmen clubs or hunting preserves, firing ranges, local law officers, and others as resources for specific information on firearms safety in general and hunting safety in particular.

2. Obtain copies of the Illinois Hunter Education manual from the Illinois Department of Conservation. This manual contains information on hunter responsibility, wildlife conservation and management, firearms, wildlife identification, game care, specialty hunting, survival and first aid, water safety, special concerns, resources, and a glossary. Included are student worksheets for study guides. Free manuals may be obtained from the Illinois Department of Conservation, Division of Law Enforcement, 524 S. Second St., Springfield, IL 62701-1787. (217) 782-6431.

3. Obtain videos on hunting education, firearms safety, and responsible hunting from the Instructional Materials Center. These include:

   9621 Hunter Education: The Only Way to Go, 16 minutes (PCP001) $90.00

   Includes: emphasis on outdoor responsibilities, The Ten Commandments of Firearm Safety, hunting's importance to wildlife management, and coping with life-threatening situations such as hypothermia.

   9622 Firearm Safety Begins in the Home, 22 minutes (PCP002) $100.00

   Includes: safe handling of longarms and handguns, transporting firearms, cleaning firearms, dangers inherent in old firearms, hobbies related to firearms, proper storage of firearms and ammunition, and an on-screen test.

   9623 The Responsible Hunter, 23 minutes (PCP003) $100.00

   Includes: an examination of such contemporary issues as trespassing, posting, the use of off-road vehicles, leasing hunting lands, and the extreme importance of hunter/landowner relationships. This video promotes ethical hunting, touches on the "anti-hunting" movement, discounts the myth that hunting threatens wildlife, and forces viewers to question their behavior and its impact on hunting's future.

4. Invite a state certified volunteer or conservation police officer to address the class on hunter safety. Further information is available from the Illinois Department of Conservation, Law Enforcement Division. (217) 782-6431.

5. Contact the National Rifle Association Education and Training Division for a list (#ASF00001) of education and training materials available. Address: NRA Sales Dept., P.O. Box 37298, Washington, DC 20036. 1-800-335-7402.

6. Plan a field trip to a sportsmen club, hunting preserve, or firing range. This trip can be used as an opportunity for presentations and demonstrations of the problem area content. Examples could include the field carry techniques and firearm cartridge propulsion differences.

7. Use pages 79 and 80 of the Illinois Hunter Education Manual as a resource list. These references may be obtained for class and student use. An alternative would be to have a student assignment to pick one of the listed sources and write that source for the particular publication. This exercise can reinforce the concepts of communication, format, and the need for protocol and correctness.

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Outdoor Recreation

PROBLEM AREA: Practicing Hunting Safety

SUGGESTED TEACHING ACTIVITIES AND PROCEDURES (con't.)

8. Use pages 81-86 of the Illinois Hunter Education Manual for definitions of terms and technical information that can be used as a basis for leading students in discussions.

9. Consider the inclusion of the related issues of trapping as an extension of hunting safety. The safety aspects of trapping and their relationship to hunting can be used as points of discussion for students. Two publications useful as resources on this topic are "Fur Trapping and the Fur Trade in Illinois" and "Trapping and Wildlife Management." Both publications are available from the Illinois Department of Conservation.

10. Consider the inclusion of ethics as a point of debate for students. Lead students in a discussion of how one's ethics can influence one's views on hunting in general and hunting safety in particular. The pamphlet, "The Ethical Hunter," contains short paragraphs useful for generating discussions on the hunter's philosophy, preparation, relationship to the landowner, attitude toward wildlife, conduct when hunting alone, respect for the law, as well as other concerns. This pamphlet is available from the Illinois Department of Conservation or the National Shooting Sports Foundation.

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Outdoor Recreation

PROBLEM AREA: Practicing Hunting Safety

REFERENCES

*1. *Illinois Hunter Education.* (1986). *Straight Shooting. Trapping and Wildlife Management. Fur Trapping and the Furtrade in Illinois.* Illinois Department of Conservation, Division of Law Enforcement, 524 S. Second St., Springfield, IL 62701-1787. (217) 782-6431.

*2. *Gun Safety Rules.* (Poster and various publications). National Rifle Association, NRA Sales Dept., P.O. Box 37298, Washington, DC 20036. 1-800-336-7402.

*3. *The Ethical Hunter.* (1988). National Shooting Sports Foundation, 555 Danbury Rd., Wilton, CT 06897.

*4. *Hunter Education: The Only Way to Go. Firearm Safety Begins in the Home. The Responsible Hunter.* (Videos). *Agricultural Resources — Technical Information* 114C. Instructional Materials Service, Texas A & M University, F.E. Box 2588, College Station, TX 77843-2588. (409) 845-6601.

*Indicates highly recommended reference

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTIONAL RESOURCES

These resources are intended for use by teachers in planning and teaching the materials for this problem area and may be adapted to fit the teaching method(s) used.

INFORMATION SHEET #1 — Hunting Regulations

INFORMATION SHEET #2 — Hunter Safety Education

INFORMATION SHEET #3 — Major Causes of Accidents

INFORMATION SHEET #4 — Straight Shooting About Alcohol and Hunting

TRANSPARENCY MASTER #1 — Parts of a Shotgun and Rifle (with discussion guide)

TRANSPARENCY MASTER #2 — Parts of a Handgun (with discussion guide)

TRANSPARENCY MASTER #3 — How a Firearm Fires (with discussion guide)

TRANSPARENCY MASTER #4 — Carrying Firearms Safely (with discussion guide)

TRANSPARENCY MASTER #5 — Safe Shooting Zones (with discussion guide)

TRANSPARENCY MASTER #6 — Ten Commandments of Shooting Safety (with discussion guide)

TRANSPARENCY MASTER #7 — Firearm Safety

INFORMATION SHEET #1

Hunting Regulations

Hunter Safety Training — Parental Permission

1. Hunters under 16 years of age must show proof that they have successfully completed the official Hunter Safety Training Course provided by the Department or must show a previous year's hunting license **and** must present written permission of their parent or guardian before the vendor can issue them a license.

2. A violation committed by a minor with the consent of or under the direct control of a parent or guardian can result in the parent or guardian being charged with the violation.

Firearm Owner's I.D. Card

Anyone who has a firearm or firearm ammunition in his or her possession must have in his or her possession a valid Firearm Owner's I.D. Card unless he or she is:

1. A licensed out-of-state sportsman hunting in Illinois.

2. Under the age of 21 and under the immediate control of a parent, guardian, or responsible adult who has in his or her possession a valid Firearm Owner's I.D. Card.

Adapted from the Illinois Digest of Hunting Regulations

INFORMATION SHEET #2

Hunter Safety Education

What is It?

The Illinois Hunter Education Program consists of a minimum eight hours of instruction. These courses cover the basics of hunter responsibility, wildlife conservation and identification, firearms and ammunition, field safety, wildlife management, first aid, archery, muzzleloading, and state regulations. The instruction may be supplemented with the use of films, flip charts, and firearm displays.

Persons completing the hours of instruction and successfully completing the final examination will receive a State of Illinois Certificate of Competency and a graduate patch.

Who Must Take The Course?

On January 1, 1976, a State law was passed requiring that no persons under sixteen years of age may be issued a hunting license unless:

a. They present a valid Hunter Safety Education Certificate of Competency issued by the Illinois Department of Conservation, Division of Law Enforcement; or

b. They present evidence they have held a hunting license issued by the State of Illinois or another state in a prior year.

Where are Courses Available?

Courses are sponsored by various conservation clubs, public service organizations, park districts, schools, and other interested organizations in the state.

Why Take a Hunter Safety Education Course?

Many states are now requiring adult hunters to furnish evidence of having completed a Hunter Safety Course prior to issuance of a nonresident license.

The shooting sports, both hunting and target, are lifetime recreational activities enjoyed by millions of Americans. The Illinois Hunter Safety Education Program was designed to improve safety and to develop an attitude of respect for wildlife and the environment.

For information on where you may take a Hunter Safety Education course contact:

Illinois Department of Conservation
Division of Law Enforcement
524 S. Second St.
Lincoln Tower Plaza
Springfield, IL 63701-1787
(217) 782-6431

INFORMATION SHEET #3

Major Causes of Accidents

Relative to other recreational activities, hunting does not have as many accidents. Those casualties which do occur can be listed under three major causes of hunting accidents: *safety violations* (especially a loaded firearm in a vehicle); *hunter judgment* (improper identification of the target or what is in the background); and *lack of skill or aptitude* (falls, loading and unloading, and catching the trigger on an object).

Statistics from the U.S. Department of Health and Human Services show that deaths from hunting accidents rank among the lowest causes for all accidental deaths.

The National Safety Council report and North American Association of Hunter Safety Coordinators (NAAHSC) accident statistics all show hunting to be safer than many other well-known sporting activities. According to the NAAHSC figures, 33 states and 8 provinces reported that 14,728,967 hunters in 1981 had a total of 1,327 firearm accidents. In other words, less than .1 percent of all hunters are involved in hunting accidents. In 1982, there were 19,079,905 hunters recorded in 45 states and 9 provinces. In 1983, 47 states and 10 provinces reported 19,077,416 hunters. The accident rate did not increase in either of these years.

In each of those years, 73 percent to 82 percent of the hunters involved in accidents were not Hunter Education course graduates. Responsible people should complete such a course before obtaining a hunting license.

Here are some examples of self-inflicted accident causes: removing or replacing a firearm in a vehicle, a firearm falling from where it was leaned, discharge in a vehicle, improper crossing of an obstacle, and horseplay. All of these accidents occur when safety rules or laws are violated. If responsible hunters follow safety rules and regulations, these types of accidents can be avoided.

Two-person hunting accidents occur in the following types of situations: when the second hunter is out of sight of the shooter, when the second hunter is covered by a shooter swinging on game, or when a hunter is mistaken for a game animal. If you identify your target and what is beyond it, and always know where other hunters are, this type of accident will not happen.

A large percentage of these accidents involve members of the same hunting party: family members or friends. Always know the location of your companions. Wear hunter orange. This colored fabric has reduced accidents by over 50 percent.

Accident Prevention

Responsible firearm handling is the key to stopping accidents. No one can halt a speeding bullet. Nor can an injury be healed by wishing it hadn't happened. Do not let it happen. Plan your hunt and hunt your plan. Set up safe shooting zones and stick to them.

Many states and provinces have regulations against carrying loaded firearms in vehicles. Be sure you know your area regulations. In some places, a firearm must be unloaded, broken open, cased, or locked in a vehicle's trunk. What are the rules where you will hunt?

Adapted from the Illinois Department of Conservation

INFORMATION SHEET #4

Straight Shooting About Alcohol and Hunting

Only an avid hunter can really understand the fine combination of relaxation, satisfaction, and excitement that a hunting trip delivers.

That enjoyment includes a responsibility for safety. Good hunters count on their firearms, their companions, and themselves for a safe trip.

Avoiding the consumption of alcohol can be just as important as safe shooting practices.

Alcohol Can Affect Your Shooting Skills

It's great to relax at night around an open fire, reminiscing about past trips and planning for the coming day. But no hunter is a match for an animal in its natural environment if the hunter's reflexes and perceptions are dulled by alcohol.

Putting alcohol in your system the night before a hunt may affect your skillfulness the next day. Vision (especially early morning vision and red/green color differentiation) can be affected by wine, beer, or spirits.

The ability to react to all of the outside stimuli that confront a hunter may be more critical than reduced vision or coordination. Alcohol can affect judgment, alertness, and a host of other senses that a smart hunter counts on for a safe and successful hunt.

Alcohol Acts Quickly

The wise hunter recognizes how alcohol can impact on his or her skills. Unlike other foods, alcohol is absorbed very rapidly into the bloodstream without having to be digested first. It can take just two or three minutes for alcohol to circulate throughout the body and affect the brain.

A straight whiskey (.60 ounces of alcohol) will get into the bloodstream faster than a drink diluted by water. Sweet sodas and carbonated mixers may actually speed up the absorption of alcohol into the blood.

A beer (.54 ounces of alcohol) may not hit as hard as a martini (.99 ounces of alcohol), but only if you pace your consumption.

Alcohol Affects Everyone Differently

We all know that alcohol can cause problems for a hunter. But just how much is "too much?" That's an easy answer when driving a car, but not so clear-cut as it pertains to hunting. Most states define too much alcohol as .1 percent Blood Alcohol Content (BAC) when testing a driver.

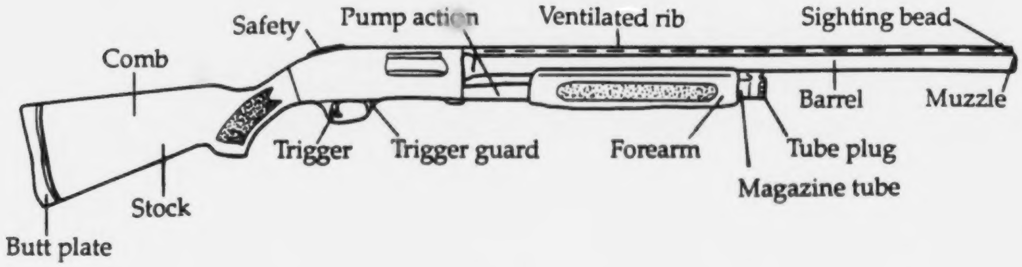
It stands to reason that if you can't drive, hunting would also be dangerous. But even lesser amounts of alcohol can affect a hunter's ability.

Adapted from the Illinois Department of Conservation

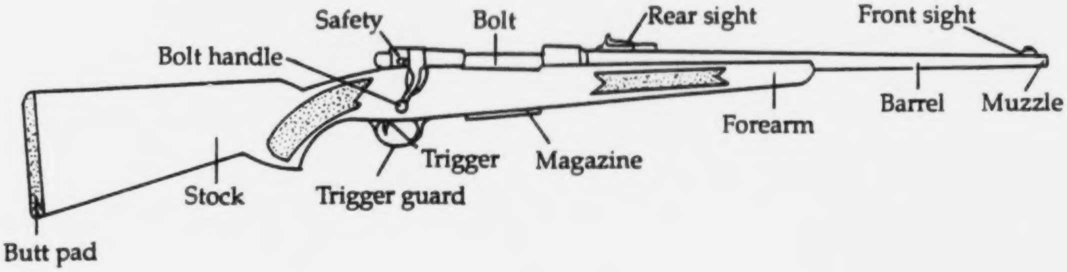
TRANSPARENCY MASTER #1

Parts of a Shotgun and Rifle

Parts of a Pump Action Shotgun

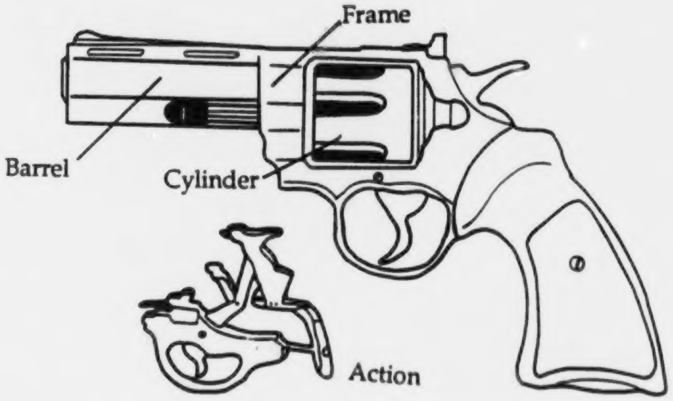

Safety
Pump action
Ventilated rib
Sighting bead
Comb
Barrel
Muzzle
Trigger
Trigger guard
Forearm
Tube plug
Magazine tube
Stock
Butt plate

Parts of a Bolt Action Rifle

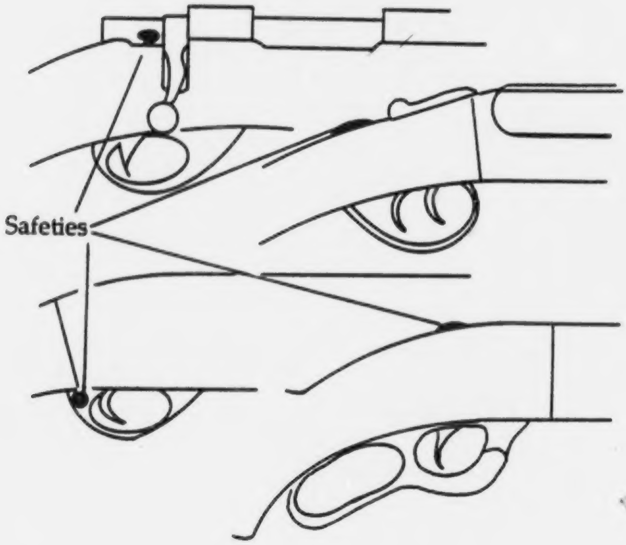

Safety
Bolt
Rear sight
Front sight
Bolt handle
Barrel
Muzzle
Forearm
Trigger
Magazine
Stock
Trigger guard
Butt pad

TRANSPARENCY MASTER #2

Parts of a Handgun

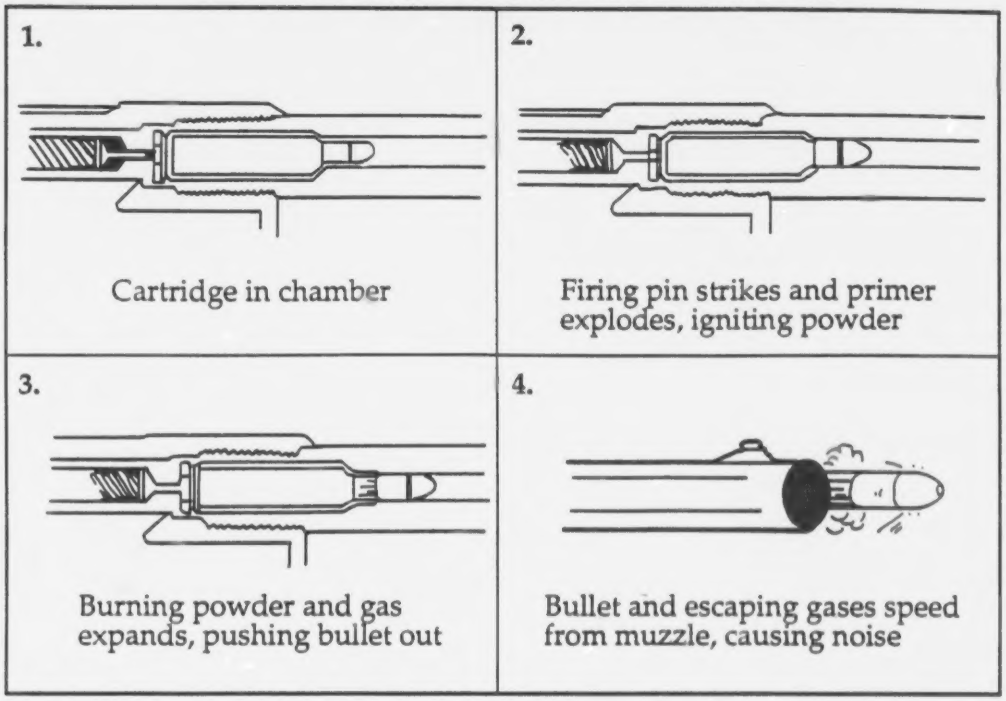

Frame
Barrel
Cylinder
Action

Safety Locations



TRANSPARENCY MASTER #3

How a Firearm Fires

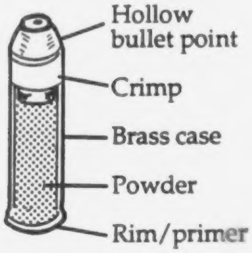

1. Cartridge in chamber

2. Firing pin strikes and primer explodes, igniting powder

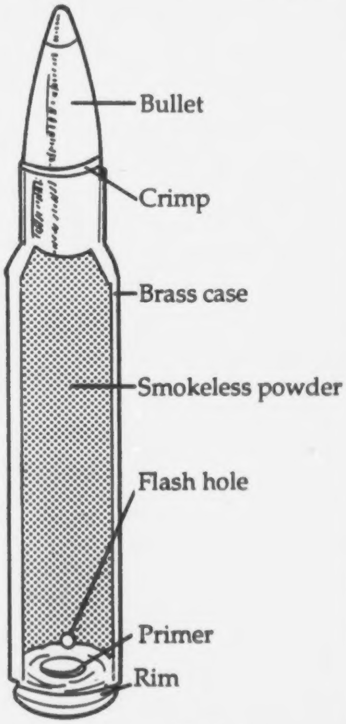
3. Burning powder and gas expands, pushing bullet out

4. Bullet and escaping gases speed from muzzle, causing noise

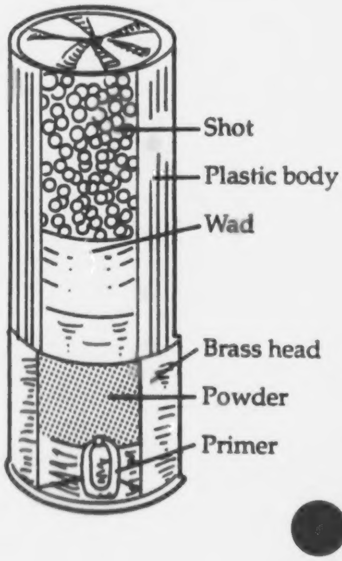
Rimfire Cartridge


Hollow bullet point
Crimp
Brass case
Powder
Rim/primer

Centerfire Cartridge

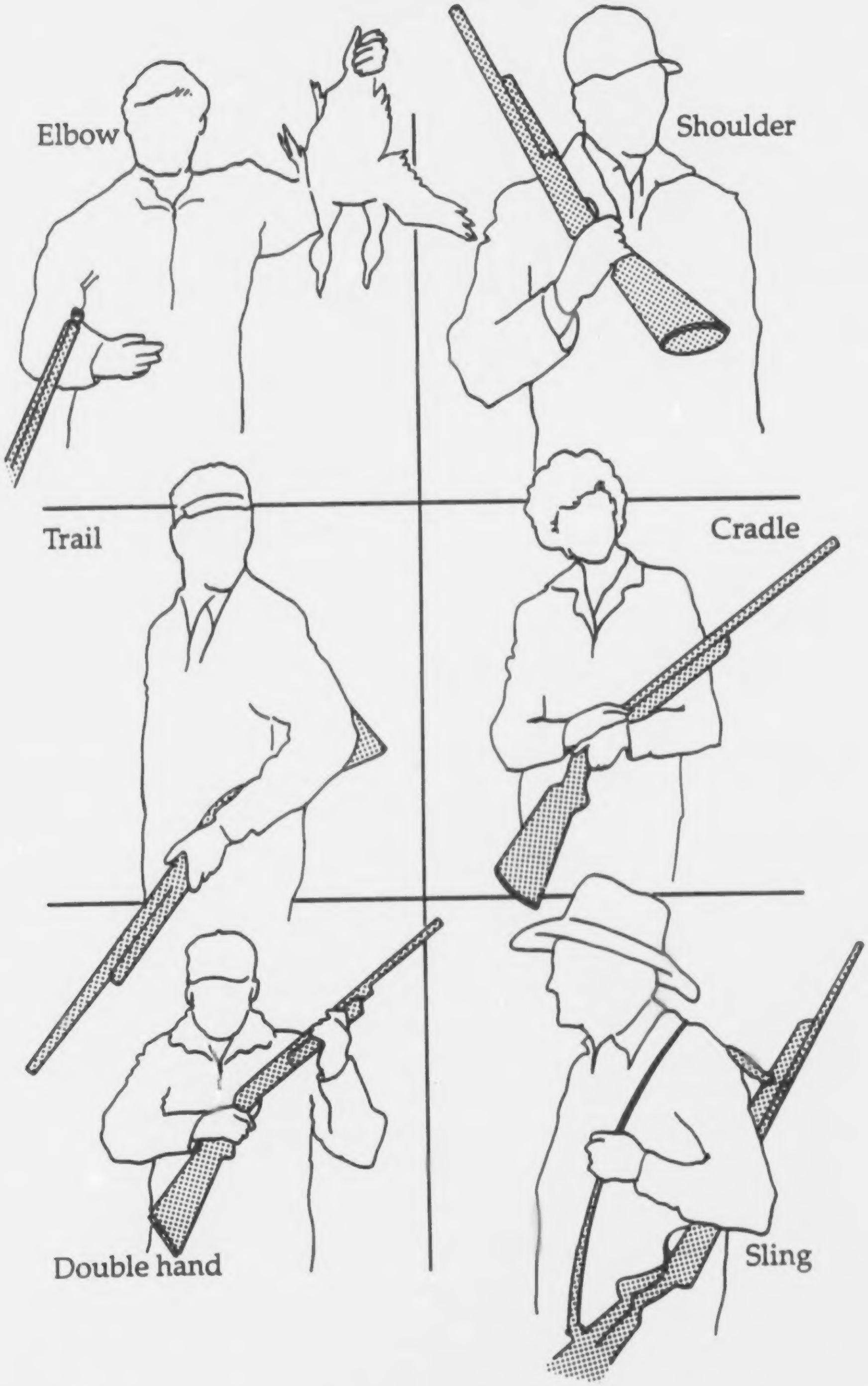

Bullet
Crimp
Brass case
Smokeless powder
Flash hole
Primer
Rim

Shotgun Shell


Shot
Plastic body
Wad
Brass head
Powder
Primer

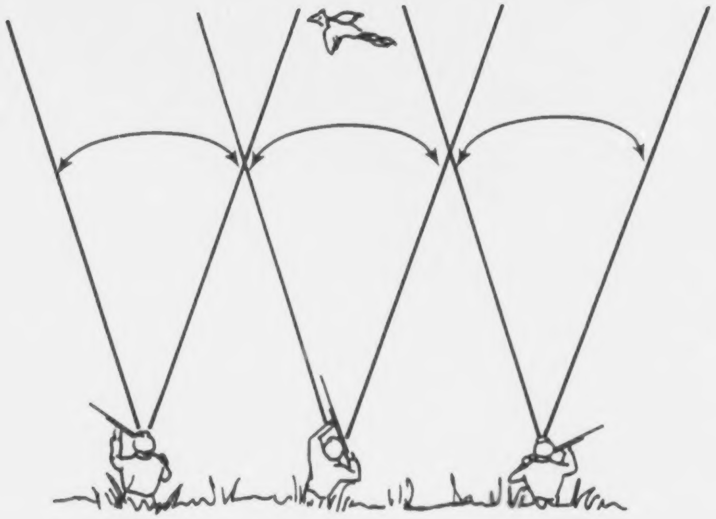
TRANSPARENCY MASTER #4

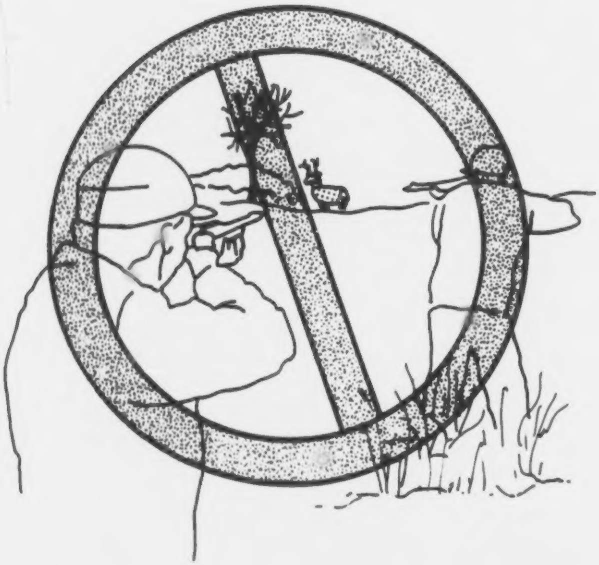
Carrying Firearms Safely


Elbow
Shoulder
Trail
Cradle
Double hand
Sling

TRANSPARENCY MASTER #5

Safe Shooting Zones





TRANSPARENCY MASTER #6

Ten Commandments of Shooting Safety

1. Control the direction of your firearm's muzzle.

2. Identify your target and what is beyond it.

3. Treat every firearm as if it were loaded.

4. Be sure the barrel and action are clear.

5. Unload firearms when not in use.

6. **Never** point a firearm at anything you do not want to shoot.

7. Never climb or jump with a loaded firearm.

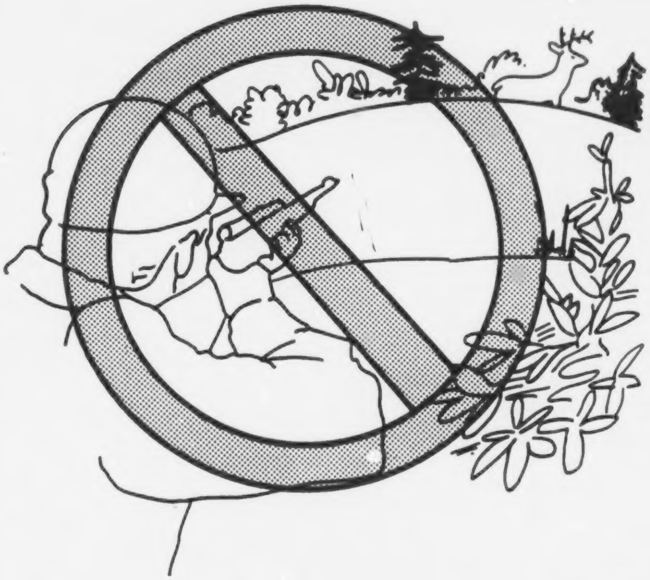
8. Never shoot at a flat surface or water.

9. Store firearms and ammunition separately.

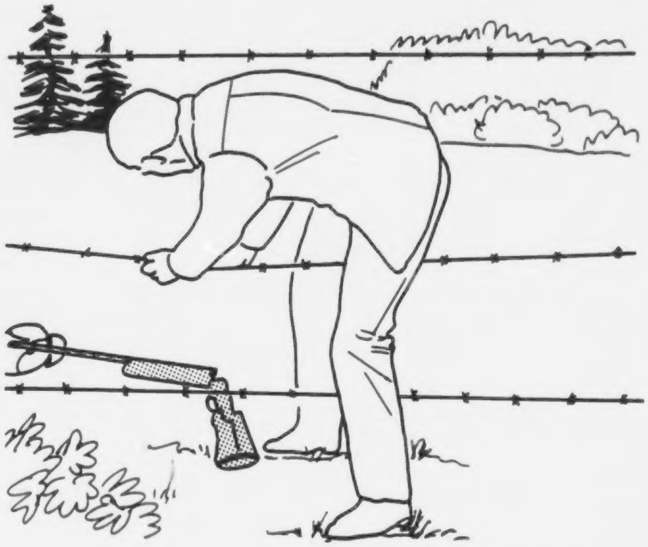
10. Avoid **all** drugs while shooting.

TRANSPARENCY MASTER #7

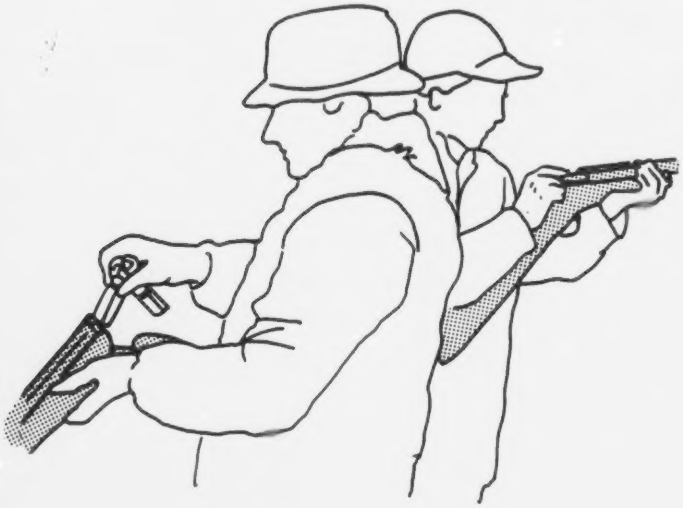
Firearm Safety



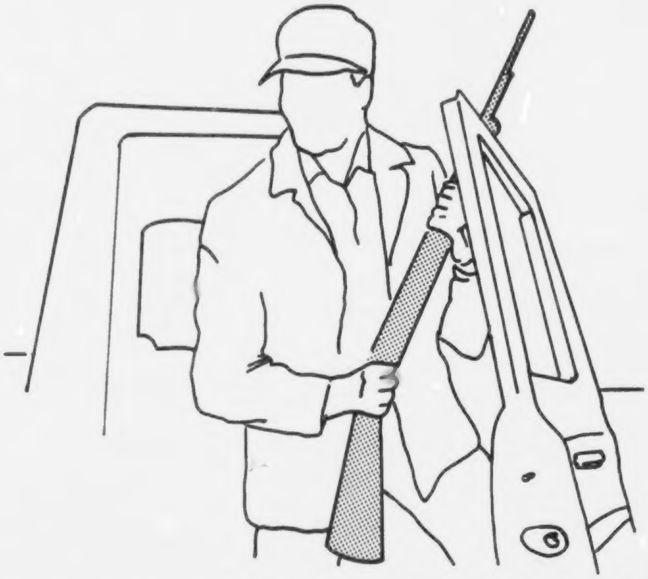
Don't take an over-the-hill shot.



Unload and open action.
Rest your muzzle on a hat.



Point a firearm in a safe direction when loading.



Don't carry a closed action firearm in a vehicle.

TRANSPARENCY MASTER DISCUSSION GUIDE

Transparency Master #1 and #2

Use pages 19-26 and 53-55 in the Illinois Hunter Education Student Manual for information on shotguns, rifles, and handguns.

Most rifles will have a safety which is designed to prevent the firearm from firing if the trigger is pulled accidentally. Safeties either prevent the trigger from being able to move or the firing mechanism from being able to work. Safe, responsible shooters will always know where the safety is located and how to operate it before learning to load and fire. The safety may be a button, movable pin, thumb lever, thumb hammer, or sliding plate. It is moved from "on" to "off" only when you are ready to fire a shot. The safety might not block the hammer or firing pin, however. A hard blow or dropping the rifle could still cause it to fire, even with the safety on. Since a safety is a mechanical device, it can fail to work. Handle each rifle responsibly even though you are positive the safety is on.

Transparency Master #3

Ammunition

Ammunition for firearms uses a variety of ignition systems. Ignition means setting fire to the propellent or powder charge.

Today's modern sporting ammunition has come a long way from the use of rocks and metal bits blown out of a tube by setting fire to black powder.

Settlers of North America needed two types of black powder, one for the primer and one for the charge itself. Sparks from the flint and frizzen ignited the priming powder which then ignited the main charge. Ball and conical bullet projectiles were used in rifled barrels which increased accuracy. The use of patches increased the speed of the loading procedure.

Percussion cap firearms made it possible to take some giant steps in ammunition making. A small cap, ignited when hit by a hammer, exploded flame through a nipple into the powder charge, setting it off. This was the last firearm to load through the muzzle.

A French engineer named Vielle developed smokeless powder in 1884. It really is neither smokeless nor a powder. It is composed of more stable chemicals and is safer to use, store, and handle than black powder. Smokeless powder comes in flakes, pellets, strips, and other shapes. It allows ammunition makers to measure more closely how much powder is placed into a cartridge. This makes it possible for each cartridge or shotshell from the same box to shoot almost the same.

By putting the primer, powder, and bullet into a case, rifle, handgun, and shotgun ammunition was easier to make. Better firearms could also be built. They were faster to load and more reliable. Cartridges made possible today's rapid-firing, efficient firearms.

Modern ammunition uses one of two primer styles, centerfire or rimfire. Large caliber rifles and all shotguns use centerfire ammunition, meaning the primer is located in the center of the cartridge base.

Rimfire ammunition has a primer mixture around the inside bottom rim of the case. A charge of smokeless powder propels a shaped bullet out of a brass case. The powder is ignited by a firing pin striking the rim. Rimfire ammunition is commonly used only in small caliber firearms such as the .22 caliber.

Both rimfire and centerfire cartridges are fired in the same way. The trigger releases the hammer that drives a firing pin into the primer area. The primer explodes, setting fire to the powder, which burns very quickly. This causes very high gas pressure which pushes the bullet or shot out of the firearm's barrel. The sudden release of gases as the bullet exits the barrel causes the sound that is heard.

Ammunition Safety

Smokeless powder develops more pressure than black powder. It made possible the development of long-range big game and military rifles, as well as modern shotguns. It should not be used in black powder firearms. Responsible, safe shooters will only use the correct powder or ammunition to avoid damage to firearms, or injuries to themselves or others.

Transparency Master #4

There are many safe ways to carry a firearm while hunting. They are pictured in the drawings shown here. Each method of carry keeps the firearm ready for use. Carrying positions are designed so that firearms do not point at other hunters.

Best control of the muzzle is given you by the *double-hand* or *ready carry*. Grasp the firearm's grip in one hand and the forearm in the other.

The *cradle carry* is a good one and does not make your arms tired. Cradle the barrel or forearm in the bend of one arm. Hold the small of the stock (grip) with the other hand.

An *elbow carry* can be used when there is no one in front of you. Hook the firearm over your elbow. Point the muzzle at the ground. Of all the carrying positions, this one provides the least muzzle control, especially if the hunter trips and falls.

A *shoulder carry* works very well in waist-high brush or in corn fields. Hold the firearm at the grip and lean it on your shoulder. The muzzle should point up. This carry should not be used if there is someone behind you.

The *sling carry* is a comfortable one for long hunts and open country. Hang the firearm from one shoulder by a sling. Point the muzzle in the air. It helps to control the firearm by gripping the sling at your shoulder with your hand on the carrying side. Take the firearm from your shoulder when crossing any obstacles.

Hold your firearm along one side of your body if you use the *trail carry*. Grip the stock with one hand. Do not use this carry when walking behind other persons.

Carrying a firearm safely is more than how you hold it. Responsible hunters will be sure the firearm's muzzle is pointed in a safe direction and that the safety is on. Your finger must be outside the trigger guard. Do not load the firearm until you are actually hunting. Use binoculars, not your telescope sight, to identify an object.

Earlier we identified a firearm as a tool. Would you begin to use any complicated tool without reading the instructions on how to work it? The basic things each hunter must know are how to operate the safety, how to safely load and unload it, and what it will do when fired.

These are some of the safe hunting skills used every day you hunt. Practice reaching for the safety until you can find it from habit. Be sure you can tell by feeling its position whether it is on or off. Then look at it to be sure.

You will load and unload a firearm many more times than you will have chances to fire it at game. Practice the steps of each procedure until they become part of your safety awareness habits.

It helps to do this using dummy ammunition. Firing ranges and clubs can assist you with this practice. Dummy ammunition should only be used under supervised range instruction. Dummy cartridges should not have a primer and you must be sure not to practice loading with live ammunition.

Safe steps for loading a firearm are:

1. Control the muzzle, pointing it in a safe direction. Be aware of the location of all other persons in your area.
2. Open the action and check it for proper operation. Leave the action open. Check the barrel for obstructions.
3. Load the magazine. This may be clip, tube, rotary, or other style. Count your cartridges or shells.
4. Close the action, loading the chamber.
5. Put the safety on. Double check it.
6. Safely carry any firearm you are using.

It is also very important to use safe unloading procedures. Some firearms can be unloaded only when the safety is off. Keep your finger outside the trigger guard and:

1. Control the muzzle, pointing it in a safe direction. Be aware of the location of all persons in your area.
2. Open the action to unload the chamber.
3. Remove the magazine.
4. Eject cartridges only if it is impossible to remove them any other way than working the action. If you must work the action to unload, do not let it completely close. Then the trigger mechanism will not engage. Use extra care with level action firearms.
5. Count your cartridges. Be sure the magazine is empty.
6. Look in both the chamber and magazine. A responsible hunter is sure when his or her firearm is empty.

Transparency Master #5

Hunting is an enjoyable form of recreation for families and groups of friends. Responsible hunters will agree, before they go on a group hunt or drive, in which direction each hunter may fire. This is called a shooter's *zone of fire*. It is common for the most experienced member of the group to personally instruct the other hunters on their zones. Following this safety rule will prevent firing in the direction of another hunter. If a shot is not safe, a responsible hunter will not take it.

One example would be three hunters working a corn field for pheasants. They walk 25 to 40 feet (7 to 12 m) apart in a line. The hunter on the left will carry her shotgun pointing to the left. She will shoot at pheasants in front of her and anywhere to her left. The hunter in the middle will carry his shotgun with the muzzle pointed ahead of him. He will shoot only at birds that rise in the middle and fly straight away. The hunter on the right will carry her shotgun pointing to the right, and will shoot at birds only in front of her and to her right. No one will fire at pheasants above or behind another hunter, or between two hunters. Pass up such a shot so that your shotgun will never point at another hunter. Do not run ahead of the line to chase a downed bird. Do not lag behind the line, putting your companions into your zone of fire.

Another example is the system used in big game hunting. Often, several drivers (people who flush out the game) will still-hunt (move slowly and carefully, watching for game between steps), while pushing game toward one or more hunters on a stand. It is very important to set a zone of fire for each hunter and to know at all times where the stander and drivers are located. No one will fire in the direction of the stander or drivers. Use a visible, distinct landmark for the stander's location, such as a tall, lone dead tree, huge boulder, or steep hill. The still-hunters will take care to remain in sight of the hunters on either side of them. They should move, as nearly as possible, at the same speed. When hunting in dense brush, responsible shooters will identify their target (and determine its sex, if regulations so state) and what is beyond it before making a safe shot. All hunters should wear hunter orange. A large percentage of two-party hunting casualties take place while driving game.

Remember, a shotgun's best shooting range is up to 50 yards (46 m). However, it will shoot 600 or more yards—more than six football fields in length.

A .22 rifle is effective within 100 yards (91.44 m), but will fire a bullet over a mile. A big game rifle such as a .270 or .308 caliber is effective to 300 yards (274 m), but can fire a bullet three miles (4.8 km) or more.

Responsible hunters will learn both the effective range and maximum range of the firearm cartridge they use. This is important because:

1. It is not sporting to shoot a bird or animal at distances at which the animal might only be wounded.
2. It is necessary to prevent harm to people who are out of sight at maximum range.

Transparency Master #6

Prevention is the solution to hunting casualties. Every hunting accident that has occurred could have been prevented. Most hunting accidents happen as a result of people ignoring firearms safety rules. Prevention involves knowing and obeying those basic safety rules.

Responsible, knowledgeable, and safe hunters will learn, remember, and follow these simple rules:

1. Control the direction of your firearm's muzzle. Carry your firearm safely, keeping the safety on until ready to shoot. Keep your finger off the trigger until ready to shoot.
2. Identify your target and what is beyond it. Know the identifying features of the game you hunt. Be absolutely sure you have identified your target without any doubt. Of equal importance, be aware of the area beyond your target. This means observing your prospective area of fire before you shoot. Never fire in a direction where there are people or any other potential for mishap. It's simple: Think first. Shoot second.
3. Treat every firearm with the same respect due a loaded firearm. Before handling a gun, you should learn how it operates. This includes knowing its basic parts, how to safely open and close the action, and how to safely remove any ammunition from the gun or magazine if loaded. Remember, a gun's mechanical safety device is never foolproof. The safety device can never replace safe gun handling.
4. Be sure the barrel and action are clear of obstructions and that you have only ammunition of the proper size for the firearm you are carrying. Most guns have their cartridge or shell type stamped on the barrel. Ammunition can be identified by information printed on the box and stamped on each cartridge. Do not fire the gun if there is any question about the compatibility of the gun and ammunition. Smaller ammunition can be accidentally placed in a gun chamber designed for larger ammunition, creating an obstruction and a very hazardous situation. Remove unfired ammunition from clothing when you're through shooting in order to avoid accidentally mixing different ammunition the next time you go shooting.
5. Unload firearms when not in use. Leave the actions open. Firearms should be carried empty in cases to and from shooting areas. Whenever you pick up any gun, immediately open the action and check to see that the chamber is unloaded. If the gun has a

magazine, make sure it's empty. If you do not know how to open the gun's action, leave it alone or get help from someone who is knowledgeable.

6. Never point a firearm at anything you do not want to shoot. Avoid all horseplay with a firearm.
7. Never climb a fence or tree, or jump a ditch or log, with a loaded firearm. Never pull a firearm toward you by the muzzle.
8. Never shoot a bullet at a flat, hard surface or water. During target practice, be sure your backstop is adequate.
9. Store firearms and ammunition separately beyond the reach of children and careless adults.
10. Avoid alcoholic beverages or other mood-altering drugs before or while shooting.

Other Concerns

Be aware that circumstances may require additional rules unique to a particular situation. The basic rules listed above for safe handling and shooting may need to be supplemented with other rules. For example, different types of ranges such as a pistol or a shotgun skeet range may have specific rules that must be learned and followed. Remember, whether in the home, at the range, or in the field, you are responsible for gun safety.

Be aware of fatigue and its effect on reactions and thinking ability.

Take time to fire a safe shot. If unsure, or if you must move too quickly, pass up the shot.

If you fall, try to control where the muzzle points. After a fall, check your unloaded gun for dirt and damage and make sure the barrel is free of obstructions.

Wear eye and ear protection as appropriate. Guns are loud. They can also emit debris and hot gases that could cause eye injury. For these reasons, safety glasses and ear protectors are recommended apparel.

No firearm safety rule ever prevented an accident. Firearm accidents are prevented when people who are handling firearms care enough to do so properly and safely. While hunting, if your companions do not follow the rules of safe firearms handling, you should refuse to hunt with them unless they are prepared to correct their behavior. Remember to be safe and not sorry for your actions.

STUDENT ACTIVITIES

STUDENT WORKSHEET #1 — Hunting Accidents

For additional activities, teachers may refer to the "Suggested Teaching Activities and Procedures" section in the Instructor's Guide.

STUDENT WORKSHEET #1

Hunting Accidents

For use with Information Sheet #3

The three major causes of hunting accidents are listed below. Types of situations which fall into these groups are shown, too. How could they have been prevented? One answer is given. Can you fill in the rest?

Cause	Situation	How to Avoid
Hunter's judgment	Mistaken for game	Be sure of your target before you pull the trigger
Hunter's judgment	Swinging past partner	
Safety or law violation	Discharge of firearm in vehicle	
Safety or law violation	Discharge of firearm crossing fence	
Safety or law violation	Safety not on	
Safety or law violation	Hunting out of season	
Lack of skill or or aptitude	Shooter stumbled and fell	

818

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Outdoor Recreation

PROBLEM AREA: Identifying Outdoor Recreational Enterprises

RELATED PROBLEM AREAS:

1. Managing Forestry Resources
2. Managing Game Preserves
3. Managing Hunting and Fishing Clubs
4. Managing Golf Courses
5. Managing Parks and Recreational Areas
6. Managing Freshwater Resources

PREREQUISITE PROBLEM AREA(S): None

LEVEL: Orientation

OCCUPATIONAL TASKS ADDRESSED: None

STATE GOALS FOR LEARNING

In planning the instruction for this problem area, teachers can promote the development of several student learning objectives which are related to the State Goals for Learning in Biological and Physical Sciences and Social Sciences. These objectives are listed on the Learning Assessment Plan forms included on the following page(s). Those learning objectives marked with an asterisk (*) are taken from the sample lists provided by the Illinois State Board of Education.

Illinois Agricultural Core Curriculum

Agricultural Education 124 Mumford Hall 1301 W. Gregory Drive University of Illinois Urbana, IL 61801

Director: Dale A. Law, Ed.D.
Principal Investigator: Jerry D. Pepple, Ed.D
Research Assistant: Kevin J. Enderlin

90/91
Agricultural Resources
Outdoor Recreation

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

Submission Date ____________

☐ Original submission ☐ Revision

Page ____ of ____

I. LEARNING AREA *(check one)*

☐ Language Arts ☐ Fine Arts
☐ Mathematics ☐ Social Sciences
☒ Sciences ☐ Physical Development/Health

(Affix label or complete district information.)

COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐

District Name

City

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will have a working knowledge of the social and environmental implications and limitations of technological development.

Contact Person: ____________
Title: ____________
Phone: (   )

III. LEARNING OBJECTIVES	IV. ASSESSMENT A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	V. EXPECTATIONS Percent of Students Expected to Achieve Objective
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:					
*1. Recognize the variety of Illinois' natural areas and relate them to economics and recreation.					
*2. Identify future vocations in science.					
3. Identify the career opportunities in outdoor recreation.					
4. Identify colleges in Illinois with degree programs in outdoor recreation and related areas.					

816

817

ISBE 41-78 (1/88)

Submission Date ____________________
☐ **Original submission** ☐ **Revision**
Page ____ of ____

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

(Affix label or complete district information.)

COUNTY	DISTRICT	ESC

District Name

City

Contact Person: ____________________
Title: ____________________
Phone: (   )

I. LEARNING AREA *(check one)*

☐ Language Arts
☐ Mathematics
☐ Sciences
☐ Fine Arts
☒ Social Sciences
☐ Physical Development/Health

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will be able to apply the skills and knowledge gained in the social sciences to decision making in life situations.

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Understand the relationship between educational attainment and entry into varied occupational fields.					
*2. Understand the knowledge and skills required for success in selected fields of work.					
3. Identify the career opportunities in outdoor recreation.					
4. Identify colleges in Illinois with degree programs in outdoor recreation and related areas.					
5. Identify the types of privately owned outdoor recreational enterprises.					

818

819

ISBE 41-78 (1/88)

Illinois Agricultural Core Curriculum Rev.

Identifying Outdoor Recreational Enterprises

Agricultural Resources
Outdoor Recreation

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Outdoor Recreation

PROBLEM AREA: Identifying Outdoor Recreational Enterprises

STUDENT LEARNING OBJECTIVES

Upon completion of their study of this problem area, students will be able to:

1. Identify the differences between unimproved and improved recreational areas.
2. Identify the types of privately owned outdoor recreational enterprises.
3. Identify which types of outdoor recreational enterprises have the highest profit potential.
4. Identify the career opportunities in outdoor recreation.
5. Formulate a plan for gaining a career in outdoor recreation.
6. Identify colleges in Illinois with degree programs in outdoor recreation and related areas.

INSTRUCTOR'S NOTES AND REFERENCES

820

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Outdoor Recreation

PROBLEM AREA: Identifying Outdoor Recreational Enterprises

PROBLEMS AND QUESTIONS FOR STUDY **INSTRUCTOR'S NOTES AND REFERENCES**

1. What is the difference between the types of recreational activities available on improved lands versus unimproved lands?
2. What types of privately owned recreational enterprises are available?
3. Which type of recreational enterprises have the greatest profit potential?
4. What are the career opportunities in outdoor recreation?
5. How should one plan for a career in outdoor recreation?
6. What Illinois colleges offer degree programs in outdoor recreation?

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Outdoor Recreation

PROBLEM AREA: Identifying Outdoor Recreational Enterprises

SUGGESTED TEACHING ACTIVITIES AND PROCEDURES

1. Identify a recreational enterprise in your area. How is it unique? How long has it been there? What do you like about it?

2. Identify a recreational enterprise you would like to work with. What types of skills are needed? How would you promote your enterprise?

3. Write one of the following associations concerning job possibilities. Share the information with the rest of the class.

   American Camping Association
   Bradford Woods
   Martinsville, IN 46151

   National Recreation and Park Association
   Division of Professional Services
   3101 Park Center Dr.
   Alexandria, VA 22302

   National Audubon Society
   Nature Centers Division
   1130 Fifth Ave.
   New York, NY 10028

4. Identify a location for a possible recreational site in your area. Develop a proposal for implementing such a project.

5. Perform a survey of the recreational enterprises in your area. Find out the types of recreational activities available, costs or fees to the users, etc.

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Outdoor Recreation

PROBLEM AREA: Identifying Outdoor Recreational Enterprises

REFERENCES

*1. *Outdoor Recreation in America, Trends, Problems, Opportunities.* Jenson, Clayne R. Burgess International Group, Inc., 7110 Ohms Lane, Edina, MN 55435. (612) 831-1344.

*2. *Career Guide: Forestry, Wildlife Management, Fisheries, Outdoor Recreation.* Illinois Department of Conservation, Information and Education, Lincoln Towers Suite 100, 524 South Second Street, Springfield, IL 62706. (217) 782-7454.

3. *Identification of Recreational Enterprises.* Instructional Materials Service, Texas A & M, F. E. Box 2588, Texas A & M University, College Station, TX 77843-2588.

*Indicates highly recommended reference

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTIONAL RESOURCES

These resources are intended for use by teachers in planning and teaching the materials for this problem area and may be adapted to fit the teaching method(s) used.

INFORMATION SHEET #1 — Two Categories of Outdoor Recreation Enterprises on Private Lands

INFORMATION SHEET #2 — Outdoor Recreational Enterprises on Privately Owned Improved Areas

INFORMATION SHEET #3 — Profit Potential of Recreational Enterprises

INFORMATION SHEET #4 — Planning a Career in Outdoor Recreation

INFORMATION SHEET #5 — Outdoor Recreation Careers in the Illinois Department of Conservation

INFORMATION SHEET #6 — Related Careers in Outdoor Recreation

INFORMATION SHEET #7 — Federal Government Careers in Outdoor Recreation

INFORMATION SHEET #8 — Outdoor Recreation Career Opportunities in the Private Sector

INFORMATION SHEET #9 — College and University Programs in Outdoor Recreation

TRANSPARENCY MASTER #1 — Ownership of Resorts

TRANSPARENCY MASTER #2 — Size of Vacation Farms in Acres

TRANSPARENCY MASTER #3 — Ownership Shooting Preserves

TRANSPARENCY MASTER #4 — Types of Outdoor Recreation Activities

TRANSPARENCY MASTER #5 — Number of Outdoor Recreational Enterprises in the United States

INFORMATION SHEET #1

Two Categories of Outdoor Recreation Enterprises on Private Lands

Of the 2.3 billion acres of land and water in the United States, about 60 percent of it is private ownership. Some of the privately owned land and water is especially designed and managed as outdoor recreation enterprises.

Outdoor recreation on private lands can be divided into two main categories:

1. That which occurs on areas which are unimproved for recreation, where recreation is a secondary use. (Such as agricultural and grazing areas which are also used for hunting and fishing in season.) Such resources are simply available in their present condition for people to use to a limited extent under certain conditions. Of the approximately 1.4 billion acres in the United States in private ownership, it is estimated that over 50 percent of it has some outdoor recreation value.

2. Recreation on privately owned improved areas. Many areas are specifically designed and managed to accommodate the outdoor recreationist. These are mostly recreation enterprises operated to produce profit. Like any other profit-producing business, recreation enterprises must be appealing to the potential paying customers and managed in a way that leaves the customers satisfied and willing to return again and again.

INFORMATION SHEET #2

Outdoor Recreational Enterprises on Privately Owned Improved Areas

Resorts

Recreation resorts are the most widespread of all privately owned outdoor recreation enterprises. They include cottages, motels, waterfront hotels, and other facilities. Resorts are usually situated on very small sites and provide such activities as swimming and sunbathing. More than 50 percent of the resorts in the nation are owned by companies or corporations. About 40 percent are owned by individuals or families. And 10 percent are owned by private clubs, partnerships, or non-profit groups. Resorts range in size from less than one acre to more than 30,000 acres. Two-thirds of resorts are 50 acres in size or more. Water sports are by far the most popular activities at resorts, with swimming being the most popular single activity. Fishing, boating, golf, and water-skiing follow in that order.

Ski Areas

Snow-skiing is one of the most fascinating of outdoor sports. Snow-skiing has grown tremendously in popularity during the last two decades. An estimated seven to eight million people ski in the United States, according to the National Ski Association of America. This number is increasing by 12 to 15 percent annually. There are more than 650 ski areas in the country. Twenty-five percent of these are rather limited and are situated on less than 50 acres. Of course, the most popular activity at ski areas is skiing, but other activities are tobogganing, sledding, cross-country touring, sightseeing, snowmobiling, ice-skating, and swimming where heated pools are available. Many ski areas have been developed into year-round resorts, providing different types of activities throughout the year.

Shooting Preserves

A shooting preserve is privately owned or leased land on which game is released for the purpose of hunting. A fee is usually charged. Good game cover is planned and cultivated. Game birds are carefully bred and reared. At maturity they are released to various areas of the preserve. There are more than 1,550 identified shooting preserves in the United States. No two shooting preserves are alike. Some operate as full-fledged resorts with many attractive features and comforts for all members of the sportsman's family. Other preserves simply provide daily fee hunting with no frills. Some preserves charge by the number of birds bagged, others by the number released, others by still different methods. More than half the identified shooting preserves are owned by individuals or families. About 20 percent are owned by private clubs and 20 percent by companies or corporations. The remaining preserves are owned by partnerships or through some other arrangement. Other activities commonly offered are picnicking, camping, hiking, horseback riding, trap, skeet and target shooting, and dog training.

Dude Ranches

A number of ranches in the United States offer vacation facilities for guests. Many of the ranches are primarily working ranches where the guests provide additional revenue. Entertainment is closely related to the work of the ranch. Conversely, at some ranches the fee paid by guests is the major source of income. Here the care of ranch livestock and production of crops frequently are of secondary interest. Nearly half of the identified dude ranches in the United States consist of 1,000 acres or more. Some are less than 100 acres, while others approach 100,000 acres or more. The most popular activity on dude ranches is horseback riding, followed by fishing, swimming, and hunting. Other popular activities are cookouts, picnics, camping, boating, pack trips, trail rides, and hiking.

Vacation Farms

Many city dwellers are sampling another very different way of life through farm vacations. A number of farm families are making their homes and their meadows, woods, streams, and pools available to paying guests. Guests benefit from the clean fresh air, from the country scenery, from being free to walk virtually wherever they choose with no restrictions, from basking in the sun and shade, and from helping with farm chores. There are more than 240 identified vacation farms in the United States. Eighty percent of these range in size from 100 to 500 acres. Ten percent are less than 100 acres, and ten percent are larger than 500 acres. There are a remarkably wide variety of recreation facilities and opportunities on the farms and on public lands nearby. Among the most popular activities are fishing, swimming, boating, hunting, hiking, horseback riding, picnicking, camping, cookouts, and lawn games. Vacation farms are on the increase and are becoming even more popular among city dwellers.

Campgrounds

Privately owned campgrounds are areas where families can pitch tents or park trailers or campers for a fee. There are more than 800 identified commercial campgrounds of this type. Practically all of these occupy a small number of acres (100 acres or less) and many of them occupy only 5 to 20 acres. However, there are a few commercial campgrounds that occupy several thousand acres. In addition to camping, additional activities available at commercial campsites are swimming, picnicking, fishing, and boating.

Outfitting, Hunting, and Fishing Camps

Specialized camps for hunters and anglers are provided in various locations throughout the nation. Such camps are concentrated in the areas where game and fish are abundant. Typically, these camps consist of a relatively small acreage where living accommodations and certain recreational facilities are provided, and are adjacent to large tracks of public or private land which is abundant with fish and game. Usually the services provided include outfitting and guided hunts and fishing trips. In the case of guided hunts, the game is often guaranteed. In addition to hunting and fishing, in some places outfitters and guides provide river float trips, canoe trips, and wilderness pack trips on horseback.

Industrial Tree Farms

Privately owned forests and timberlands serve as an important recreational outlet for thousands of Americans each year. These forests are prime examples of private enterprise serving the expanding outdoor recreation need of the public. In many such forests, there is rarely a waiting line for picnic tables, fire places, and campsites. Most facilities are free or cost very little.

Interesting facts concerning facilities provided on privately owned forest lands are:

1. A total of 61.4 million acres of privately owned forest land is open to the public for recreation.
2. Within these lands there are more than 86,000 miles of privately owned roads open to visitors.
3. An additional 700,000 acres of natural and artificial lakes are available to the public.

Commercial Beaches

In many sections of the United States, most of the shoreline has been developed with private homes and thus is not available for public recreation. In other sections, hotels, motels, and private clubs have acquired long stretches of private waterfront. In many areas of the nation, commercial beaches provide the only opportunity for people of limited means to enjoy, for a small fee, swimming, sunbathing, and in some places, boating and fishing. Commercial beaches are found along the shores of many rivers, lakes, and bays. Still others are located along the shores of the Atlantic and Pacific oceans and the Gulf of Mexico. Commercial beaches range in size from less than one-half acre to more than 1,000 acres.

Yacht Clubs

Pleasure boats are no longer solely the playthings of the well-to-do. The ability of people to own boats of all kinds is reflected in the increasing number of yacht clubs. There are more than 1,200 identified yacht clubs in the United States. Typically, yacht clubs do not occupy large acreages. Approximately 65 percent occupy five acres or less, while 15 percent occupy five acres or more. Of course, the most popular activities at yacht clubs are boating, boat racing and sailing. Other popular activities are swimming, fishing, picnicking, tennis, and social activities. Many of the clubs are commercial operations where facilities are available to nonmembers at established fees. One of the great restricting factors in the establishment of new yacht clubs is the declining availability of suitable facilities and areas to accommodate them.

Boat Clubs

Boat clubs differ from yacht clubs primarily in the kind of boats owned by members. Outboard motorboats of various sizes and the smaller inboard boats are the principal type found in boat clubs. There are over 500 boat clubs in the United States. Boat clubs serve primarily their own members. But in many cases, services are available to nonmembers at a fee.

Industrial Recreation Areas

Many industrial firms provide outdoor recreation areas for their employees. Sometimes they are adjacent to the industrial plant and in other cases they are displaced from the plant location. The areas vary in size, ranging from only a few acres to over thousands of acres in some cases. Industrial recreation is gradually and steadily increasing in popularity.

Private Power Companies

Where such a need is clearly demonstrated, a number of private power companies have provided opportunity for fishing, boating, camping, picnicking, and other water-related interests at their reservoirs. Usually the services to the public are free of charge, but sometimes nominal fees are charged to help offset the expense of providing recreational opportunities.

827

INFORMATION SHEET #3

Profit Potential of Recreational Enterprises

Some Americans are entering into recreational enterprises for profit. As the demand for outdoor recreational experiences continue to grow, more and more Americans are finding a larger percentage of their income going to outdoor recreation activities. The ownership of outdoor recreational enterprises may range from one person to the stockholders of a corporation. The table below shows which recreational enterprises have the potential for high profits.

Potential	**Enterprise**
High potential	Campgrounds for travelers
	Urban recreation facilities
	Organization camps
	Amusements parks
	Resorts
	Horse stables
	Boating facilities
	Downhill skiing
Medium potential	Picnicking
	Fishing
	Some hunting (preserves, leases)
	Off-road vehicle trails and courses
	Snowmobile trails and courses
	Interpretive activities
Low potential	Backcountry recreation use
	Large area activities—hunting, remote camping, boating
	Driving for pleasure
	Wilderness
	Wild and scenic rivers preservation
	Trails

INFORMATION SHEET #4

Planning a Career in Outdoor Recreation

How to Get Started

1. Select a career(s) that is of interest to you.
2. Write for brochures and other information about the career.
3. Check the library for additional information.
4. If possible, talk with someone currently working in that career.
5. Determine what training and education is needed.
6. Discuss your interests and plans with a guidance counselor.
7. If college training is necessary, obtain a catalog by writing to the school of your choice. (High school counselors often have copies of these available for review.) Study the courses and degrees it offers. A good program should involve both classroom work and field studies.
8. Apply for summer jobs related to your career interests. This guide contains a special section on jobs you can apply for. Experience from summer jobs will help you determine if your career choice is the right one for you. Remember, a summer job may lead into full-time employment.

Illinois Department of Conservation

INFORMATION SHEET #5

Outdoor Recreation Careers in the Illinois Department of Conservation

District Fisheries Biologist

Duties: The district biologist is responsible for the management of all state and public waters in a 4 - 5 county area. Assistance includes habitat evaluation and improvement, fish population control, vegetation control, stocking programs, and creel census. Fisheries biologists are also called upon to investigate fish kills caused by pollution.

Conservation Police Officer

Duties: The conservation police officer is responsible for enforcing the laws pertaining to fish and wildlife, snowmobiles, boats, endangered species, and statutes related to the operation of state parks. The C.P.O. investigates poaching, vandalism, hunting and boating accidents, and fish kills due to pollution. The officer also cooperates with other law enforcement agencies.

Public Information Officer

Duties: The public information officer may be called upon to perform a variety of duties involving communication skills. These duties may include producing radio and television shows, taking still photographs, researching and writing press releases and feature stories, designing brochures, and preparing other materials regarding conservation programs.

Archaeologist

Duties: Archaeology is the scientific study of ancient peoples and their culture. One of the archaeologist's main responsibilities is to survey an area for potential sites. During the survey, the archaeologist may conduct a small test dig. If the results are promising, a full-scale excavation may be undertaken. During the excavation, the exact location of each relic is noted. Then it is preserved and cataloged. It is only through research, study, and evaluation of data that the archaeologist can reconstruct a culture.

Conservation Engineer

Duties: The conservation engineer is responsible for projects that require an engineer's expertise. Projects may involve public water supply systems, waste water treatment systems, small buildings, roads, boat ramps, docks, bridges, dams, levees, and erosion control. The conservation engineer follows a project from its concept through the design and construction stage.

Interpreter/Naturalist

Duties: Many people compare the role of the interpreter to that of a teacher. The interpreter/naturalist is responsible for helping visitors become more familiar with a park's natural features, its history, and its facilities. The interpreter leads nature hikes and gives special presentations on such topics as edible wild foods, star gazing, historic arts and crafts, pioneer skills, the geology of the park, etc. He or she also conducts evening campfire programs. In parks that have a nature center, the interpreter plans and may actually construct the displays and exhibits. Interpreters assist in research projects designed to learn more about the history of the park and the flora and fauna found there.

Site Superintendent—Historic Site

Note: A historic site may be similar to a state park but has as its main focus the preservation and interpretation of history.

Duties: The superintendent of a historic site is responsible for site maintenance, historical research, restoration, care of museum collections, and developing and providing interpretation programs. To interpret the site's historical significance, the site superintendent may plan special events to demonstrate crafts, tools, and machinery from the period; carry out historic farming practices; and recreate important events. The site superintendent is also responsible for maintaining campgrounds, trails, and other recreational facilities.

Site Superintendent—State Park

Duties: The site superintendent's main role is that of a manager. He or she works with the District Forester, Wildlife Biologist, and Fisheries specialist to implement their recommendations and management plans. The site superintendent supervises the maintenance and operation of recreational facilities including camping and picnic grounds, hiking trails, boat docks and launching ramps, nature centers/museums, etc. The superintendent is administratively responsible for preparing the budget; keeping records on campground fees, employee time sheets, work schedules; ordering supplies and materials; maintaining public relations, etc.

District Forester

Duties: The district forester provides professional forestry assistance to landowners, industry, and governmental agencies in a four-county area. Such assistance includes timber cruising (woodland inventory), marking timber for harvest or improvement, developing management and restoration plans, conducting sawmill surveys, handling insect and disease cases, reviewing environmental impact statements, and conducting educational activities.

District Wildlife Biologist

Duties: The district wildlife biologist is responsible for all wildlife management activities in a 4-5 county area. The biologist provides assistance to landowners, government agencies, and other conservation groups in the areas of habitat development, wildlife population surveys, hunting programs, and management of non-game species.

Wildlife Area Manager

Note: Duties described here are for the management of river area with extensive bottomlands. Each fall the lands are flooded to provide additional habitat.

Duties: The wildlife area manager plants and cultivates feeding areas for migratory waterfowl management, and coordinates efforts in progressive wildlife management with the district biologist, U.S. Fish and Wildlife Service, and the Corps of Engineers. The manager also administers a hunting program, and maintains levees and pumps used to flood the bottomlands.

Natural Heritage Biologist

Duties: The natural heritage biologist serves as an advisor to the manager of a nature preserve and/or assists in managing the preserve. He or she conducts long-range ecological studies, evaluates and inventories flora and fauna, makes recommendations on the eradication of non-native species, supervises prescribed prairie burns (the burn retards the growth of woody plants and removes thatch, thus enabling seeds to reach the soil and germinate), carries out research and prepares management plans. The biologist also advises other governmental agencies and private landowners in the preservation and management of natural areas.

Maintenance Worker

Duties: The maintenance worker reports to the Ranger or Site Superintendent. He or she mows the grass in picnic areas and campgrounds, picks up litter and garbage, cleans restrooms and shower buildings, operates heavy equipment, does minor construction, makes plumbing repairs, paints picnic tables and shelters, etc.

Illinois Department of Conservation

INFORMATION SHEET #6

Related Careers in Outdoor Recreation

Geologist

Duties: Geologists deal with the physical structure of the earth. In a broad sense of the term "physical structure," they study the earth's crust and its movements, mineral deposits, and the formation of landforms such as mountains, valleys, plains, caves, etc. Geologists are employed by various mining industries, the petroleum industry, government agencies, mapping agencies, and by universities, as teachers.

Soil Conservation Specialist

Duties: The soil conservation specialist advises farmers, consumers, foresters, park managers, etc., in soil conservation practices. The specialist conducts soil tests, prepares maps showing the location and characteristics of various soils, works to prevent erosion and to protect watersheds (rivers, lakes, and streams) from siltation. He or she works with contractors to determine suitability of the soil for the construction of lakes, dams, levees, roads, homes, large buildings, campgrounds, etc.

Entomologist

Duties: The entomologist is concerned with the scientific study of insects including their beneficial and detrimental effects, diseases which they transmit, and control methods. Entomologists often advise farmers, foresters, and gardeners on problems.

Marine Biologist

Duties: Marine biology is a broad career title referring to the study of life forms of the seas and oceans. The marine biologist is often involved in research projects such as the effect of commercial fishing on fish population and the effect of pollution the on growth and reproduction of marine life. The marine biologist may also work as an interpreter or superintendent of a park which lies adjacent to the ocean.

Illinois Department of Conservation

INFORMATION SHEET #7

Federal Government Careers in Outdoor Recreation

U.S. Department of Agriculture

Forest Service

Responsible for the national forests and grasslands. Forest Service lands are managed on a multiple-use basis for recreation, wildlife, and timber production. Assistance is provided to state foresters and private landowners in fire control, wildlife management, and timber production. The Forest Service also conducts a variety of research projects.

Soil Conservation Service

Provides information and assistance on soil and water conservation. The Soil Conservation Service helps finance community projects designed for flood control, watershed protection, and wildlife habitat improvements. The service also publishes soil surveys noting the limitations and suitability of soils for the construction of homes, lakes, dams, etc.

Extension Service

Serves as the educational arm of the Department of Agriculture. Information and assistance is offered by county extension agents to farmers, homemakers, and youth. The Extension Service sponsors the 4-H program.

Positions include forester, ranger, forest fire specialist, wildlife biologist, maintenance worker, fisheries biologist, soil scientist, hydrologist, engineer, interpreter/naturalist, law enforcement officer, archaeologist, entomologist, chemist/researcher, extension agent, and supporting services staff (clerks, typists, accountants, etc.).

U.S. Department of Interior

Fish and Wildlife Service

Responsible for managing and protecting fish and wildlife resources. The Fish and Wildlife Service operates fish hatcheries and wildlife refuges, monitors the movement and condition of migratory birds and endangered species, conducts research, and provides financial aid to states for the acquisition of wildlife habitat.

National Park Service

Manages national parks, monuments, and scenic riverways for recreational use, historical preservation, and the protection of natural features. The Park Service conducts a variety of interpretive programs aimed at helping visitors enjoy their stay while learning more about the park's flora and fauna and historical value.

Heritage Conservation and Recreation Service

Administers the Land and Water Conservation Fund which provides matching grants to states and cities for the acquisition and development of outdoor recreation areas. The service also administers historical preservation funds for the acquisition, development, and restoration of historical structures; and provides technical assistance to other governmental agencies in the areas of outdoor recreation and historic preservation.

Water and Power Resources Service (formerly Bureau of Reclamation)

Responsible for the development and use of water resources on federal lands in western states. The Water and Power Resources Services oversees the supplying of water to municipalities and industry, and to agriculture for its irrigation needs. The service is responsible for the production of power through hydro-electric projects and is investigating wind generators and other energy sources. The service also has a program of fish, wildlife, and forestry management. In addition, recreational facilities such as campgrounds are provided at many sites.

Bureau of Land Management

Administers about 60 percent of all federally owned lands, located mainly in the western states. Lands are administered under a program involving outdoor recreation, fish and wildlife management, livestock grazing, timber production, watershed protection, and mineral production.

Geological Survey

Publishes and distributes maps and reports covering the nation's physical features and its mineral, energy, and water resources.

Bureau of Mines

Conducts programs to develop information and technology needed to supply our mineral and material needs, while minimizing harm to the environment and the workers involved. The bureau conducts research, and also collects and analyzes statistics on the extraction, processing, use, reuse, and disposal of minerals and raw materials.

Positions include: forester, range manager, geologist, wildlife biologist, fisheries biologist, landscape architect, law enforcement officer, botanist, park manager, soil specialist, cartographer, supporting services staff member, and game warden.

U.S. Department of Labor

Job Corps

Operates Civilian Conservation Centers. Programs involving work experience, training, and remedial education are focused upon activities that conserve, develop, or manage public resources and recreational areas.

Illinois Department of Conservation

834

INFORMATION SHEET #8

Outdoor Recreation Career Opportunities in the Private Sector

Timber Industry

Firms such as Georgia Pacific and Weyerhaeuser have extensive forest holdings. The timber on these lands is used to supply lumberyards, hardware stores, and home buildings. Private industry is engaged in a great deal of forestry research designed to improve growth, to develop trees that are resistant to disease and drought, and to create new products from wood and wood waste. Many companies are actively involved in replanting areas after a timber harvest. Positions include executives, marketing specialists, foresters, chemists, soil scientists, hydrologists, wildlife specialists, entomologists, and logging and maintenance crews. Requirements vary from no experience to highly specialized college training.

Law

In the early 1970s, several firms began specializing in Environmental Law. They handle cases involving the protection of endangered species, preservation of natural lands, liability involving chemical spills, etc. While this field is fairly new, information on a law career may be obtained from the nearest Bar Association.

Outdoor Recreation Equipment Manufacturers

The United States has experienced a rapid growth in camping, canoeing, backpacking, mountain climbing, skiing, horseback riding, sailing, etc. The demand for outdoor recreation equipment has also grown. Positions in this industry might include executives, marketing specialists, product designers, engineering specialists, sales managers, and assembly line workers. Requirements vary from no experience to technical school or college training.

Private Outdoor Schools

With the increase in outdoor recreation participation, a large number of private outdoor schools have been founded in recent years. Outward Bound, National Outdoor Leadership School, and the Nantahala Outdoor Center are just a few of the hundreds of private schools that exist throughout the United States. The purpose of these schools may vary, but the use of wilderness areas is a factor common to all. Positions include administrators, managers, and instructors. Instructors may be required to teach mountain climbing, white water canoeing, backpacking, orienteering, spelunking (cave exploration), scuba diving, etc. In the best schools, instructors are highly skilled individuals with years of experience in their field.

Guide Industry

Operating in some of the true wilderness areas of the U.S. and Canada, and on lakes and streams everywhere, is the little known guide industry. For a fee, a fisherman, hunter, backpacker, or canoer can hire an individual to guide his trip. A good guide knows the best fishing spots, what bait the fish are biting, where the scenic spots are, good hiking routes, etc. Some guides will provide all the equipment needed and prepare camp meals (for a fee, of course). The guide is a rare individual. His or her expertise comes from many years of experience in the outdoors.

Outfitters

The outfitter provides an individual or a group with equipment and supplies for a trip. The outfitter is basically in the rental business, although the operation staff may also include guides. The outfitter spends a great deal of time shuttling people and equipment to the starting point of a trip and back from the end point. Many hours are also spent on the repair of equipment. There are no clear-cut requirements, although business management skills, knowledge of and experience in the services offered, basic maintenance skills, and a great deal of patience are helpful.

Private Campground Manager

Still another outgrowth of increased recreation participation is the privately owned campground. Private campgrounds tend to fall into two categories: the franchised operation such as KOA, Jellystone Park, and Safari International, or the independently owned facility. Franchised campgrounds usually require a cash investment which varies from company to company. The franchise firm may offer assistance in design and engineering. It may also offer training programs and services such as advertisements in the media and a listing in its campground directory. The individual campground operator is really on his or her own. Since this is basically a business enterprise, experience in business management is required. The individual must have knowledge or seek expertise in site selection, soils, hydrology, site planning and design, and construction techniques.

Youth Agencies

A limited number of outdoor-related jobs exist within the Girl Scouts, Boy Scouts, Camp Fire Program, YMCA/YWCA, Easter Seals, etc. A surprisingly large number of churches operate summer camps and retreat centers. To determine the type of positions available and the requirements for each, it is best to contact the agency directly.

Illinois Department of Conservation

INFORMATION SHEET #9

College and University Programs in Outdoor Recreation

University of Illinois Urbana, IL 61801 (217) 333-1000	Forestry: B.S., M.S. Wildlife Research: M.S, Ph.D. Landscape Architecture: B.L.A. Environmental Studies Urban and Regional Planning: B.A., M.S. Ecology, Ethology, and Evolution: B.A. Leisure Studies: B.S., M.S., Ph.D.
Western Illinois University Macomb, IL 61455 (309) 298-1272	Recreation and Park Administration: B.S., M.S. Wildlife: B.S.
Southern Illinois University Carbondale, IL 62901 (618) 453-2121	Forestry: B.S., M.S. Forestry Recreation: B.S., M.S. Wildlife: M.S., Ph.D. Fisheries: M.S., Ph.D. Plant and Soil Science: B.S., M.S.
Southern Illinois University Edwardsville, IL 62026 (618) 692-2770	Earth Science: B.S., M.S. Planning: B.S., M.S. Recreation: B.S., M.S.
Northern Illinois University DeKalb, IL 60115 (815) 753-1000	Camping and Outdoor Recreation: B.S., Ed.; M.S., Ed. Natural Environmental Systems: B.S.
Northeastern Illinois University 5500 N. St. Louis St. Chicago, IL 60625 (312) 583-4050	Leisure Studies: B.A. Geography and Environmental Studies: B.A., M.S.
Eastern Illinois University Charleston, IL 61920 (217) 581-2223	Recreation: B.S. Environmental Biology: B.S., M.S.
Illinois State University Normal, IL 61761 (309) 438-2181	Recreation and Park Administration: B.S. Environmental Health: B.S. Geography: B.S. Geology: B.S. Horticulture: B.S.
Sangamon State University Shepherd Rd. Springfield, IL 62703 (217) 786-6600	Environments and People: M.S.

George Williams College
555 N. 31st St.
Downers Grove, IL 60515
(312) 964-3100, ext. 215

Recreation Services: B.S.
- Program Supervision
- Recreation Administration
- Therapeutic Recreation
- Recreation Resource Program
- Outdoor Leader

Advanced Professional Studies in Leisure and Environmental Resources Administration: M.S.
- Administration of Organized Camping
- Interpretive Services Administration
- Environmental Education Administration
- Outdoor Recreation Resource Management
- Urban Parks and Recreation Administration
- Individual Concentration

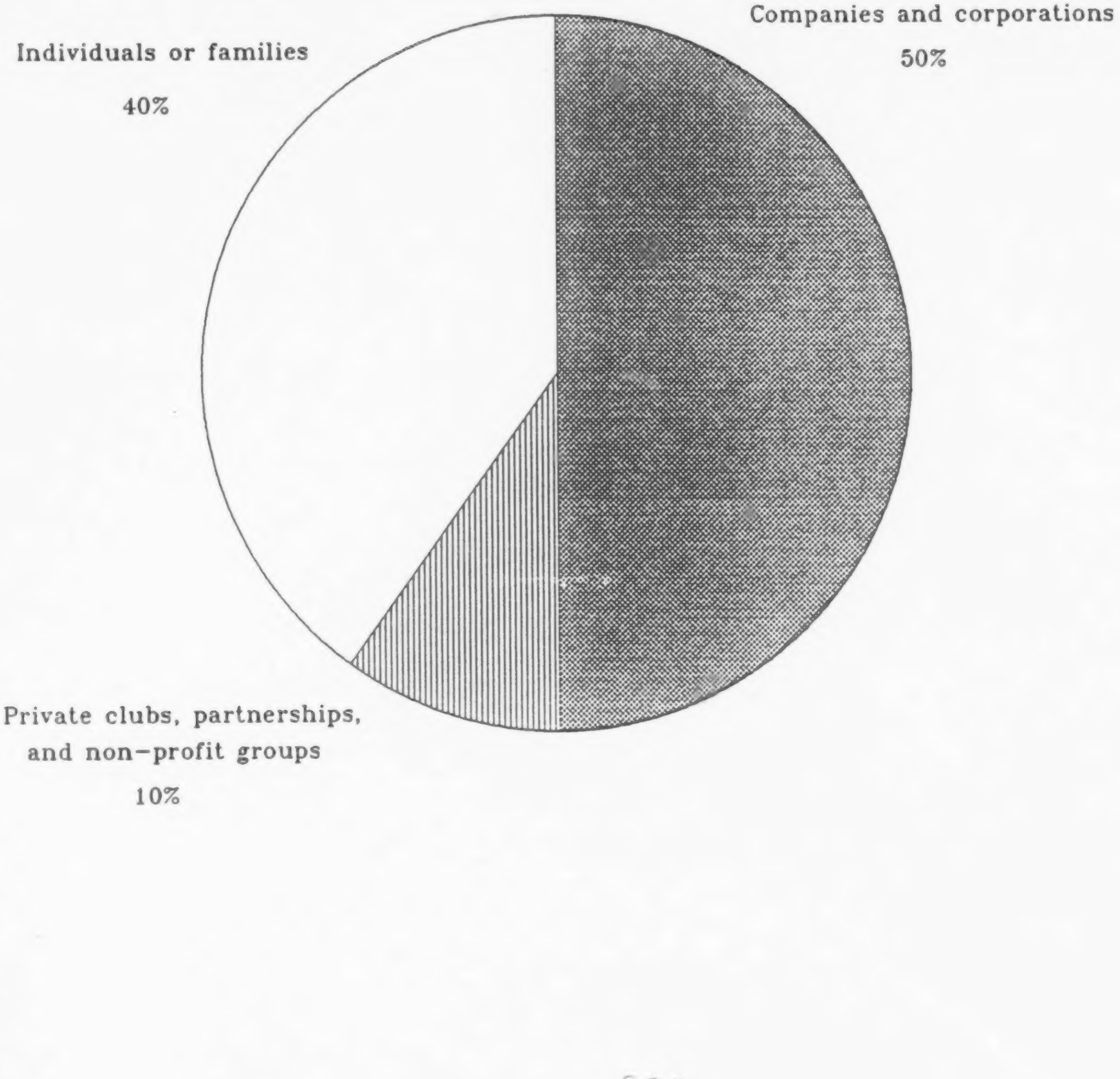
Southeastern Illinois College
Route #4
Harrisburg, IL 62946
(618) 252-6376

Two year Forestry Technician: Program A.A.

Illinois Department of Conservation

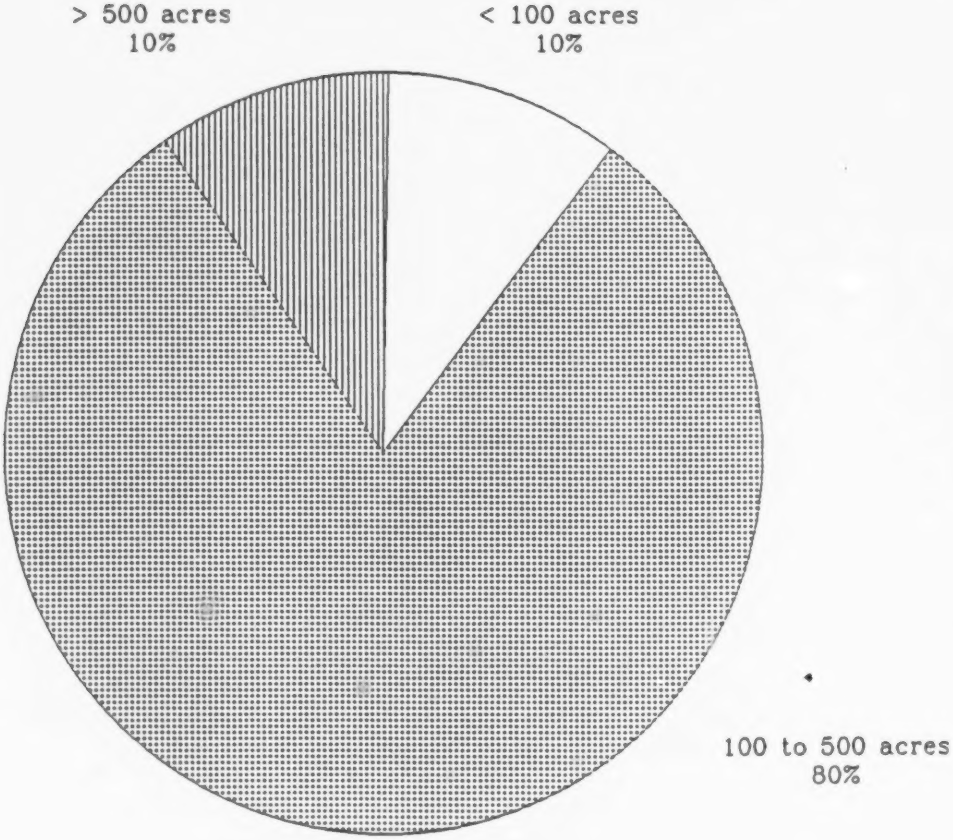
TRANSPARENCY MASTER #1

Ownership of Resorts



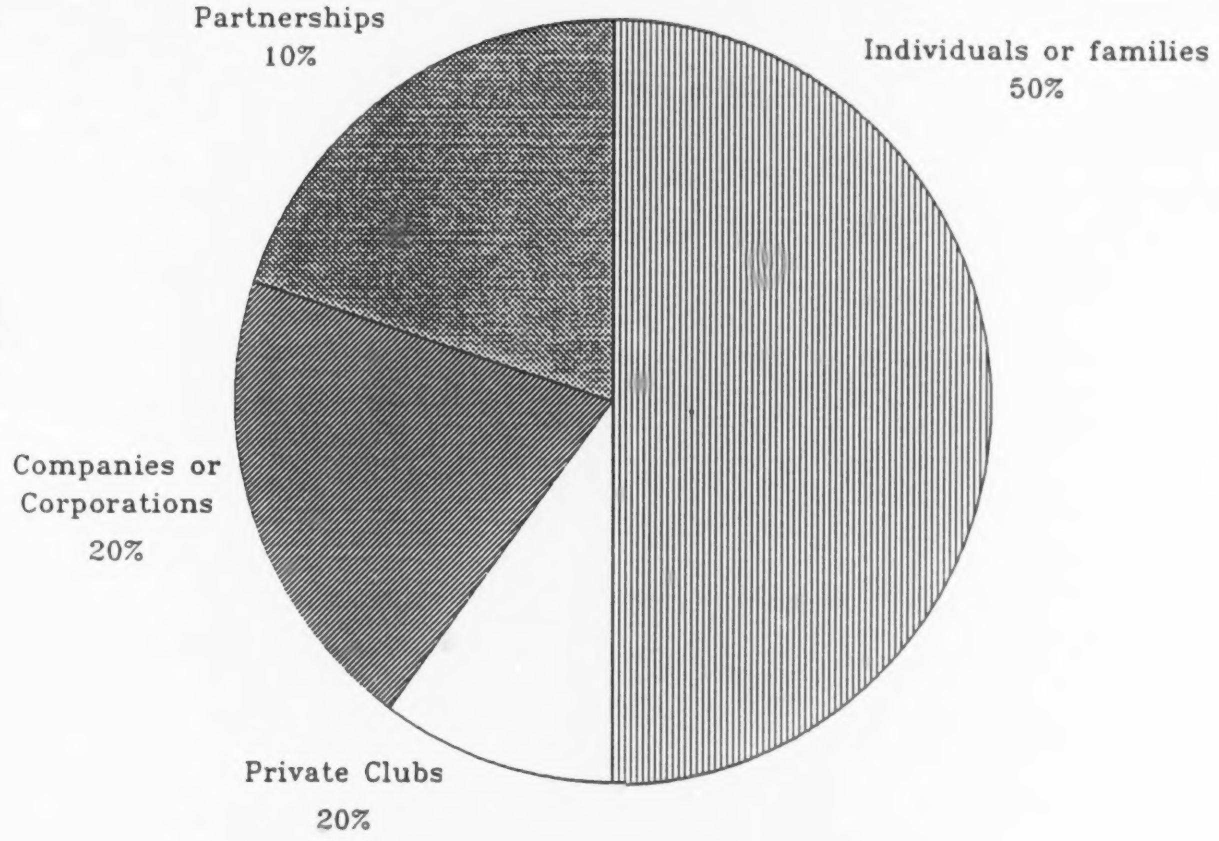
TRANSPARENCY MASTER #2

Size of Vacation Farms in Acres



TRANSPARENCY MASTER #3

Ownership Shooting Preserves



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TRANSPARENCY MASTER #4

Types of Outdoor Recreation Activities

Winter Sports

- Downhill skiing
- Cross country skiing
- Sledding
- Snowmobiling

Water-Based Activities

- Canoeing
- Motorboating
- Sailboating
- Swimming

Land-Based Activities

- Bicycling
- Hiking
- Horseback riding
- Off-road vehicles
- Camping

TRANSPARENCY MASTER #5

Number of Outdoor Recreational Enterprises in the United States

Ski Areas	650
Shooting Preserves	1,550
Vacation Farms	240
Private Campgrounds	800
Yacht Clubs	1,200
Boat Clubs	500

STUDENT ACTIVITIES

STUDENT WORKSHEET #1 — Outdoor Recreational Enterprises

For additional activities, teachers may refer to the "Suggested Teaching Activities and Procedures" section in the Instructor's Guide.

STUDENT WORKSHEET #1

Outdoor Recreational Enterprises

Describe each of the following outdoor recreational enterprises in terms of types of recreational activities available to the user.

1. Resorts:
2. Ski Areas:
3. Shooting Preserves:
4. Dude Ranches:
5. Vacation Farms:
6. Campgrounds:
7. Outfitting, Hunting, and Fishing Camps:
8. Industrial Tree Farm:
9. Commercial Beaches:
10. Yacht Clubs:
11. Boat Clubs:
12. Industrial Recreational Areas:
13. Private Power Companies:

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Outdoor Recreation

PROBLEM AREA: Adhering to Laws and Regulations

RELATED PROBLEM AREAS:

1. Identifying Outdoor Recreational Enterprises
2. Managing Parks and Recreational Areas
3. Understanding Government Regulations and Controls
4. Understanding the Relationship Between Agriculture and the Environment (Central Core Cluster)

PREREQUISITE PROBLEM AREA(S): None

LEVEL: Orientation

OCCUPATIONAL TASKS ADDRESSED:

Agricultural Resources Cluster

Duty A: Managing the Recreational Facility

1. Contribute to annual park management update
2. Assist in development of resource conservation plans

Duty B: Applying Laws, Regulations, and Policies

1. Request visitors to voluntarily comply with rules and regulations
2. Report violations to the appropriate authority
3. Interpret Environmental Protection Agency (EPA) regulations

Duty H: Applying Safety Practices

1. Comply with safety requirements for working around automated equipment

STATE GOALS FOR LEARNING

In planning the instruction for this problem area, teachers can promote the development of several student learning objectives which are related to the State Goals for Learning in Biological and Physical Sciences and Social Sciences. These objectives are listed on the Learning Assessment Plan forms included on the following page(s). Those learning objectives marked with an asterisk (*) are taken from the sample lists provided by the Illinois State Board of Education.

CORE

Illinois Agricultural Core Curriculum

Agricultural Education 124 Mumford Hall 1301 W. Gregory Drive University of Illinois Urbana, IL 61801

Director: Dale A. Law, Ed.D.
Principal Investigator: Jerry D. Pepple, Ed.D
Research Assistant: Kevin J. Enderlin

Illinois Agricultural Core Curriculum Rev.

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

Submission Date ____________
☐ Original submission ☐ Revision
Page ____ of ____

(Affix label or complete district information.)

COUNTY	DISTRICT	ESC

District Name
City
Contact Person: ____________
Title: ____________
Phone: (   )

I. LEARNING AREA *(check one)*

☐ Language Arts
☐ Mathematics
☒ Sciences
☐ Fine Arts
☐ Social Sciences
☐ Physical Development/Health

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will have a working knowledge of the social and environmental implications and limitations of technological development.

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Recognize the variety of Illinois' natural areas and relate them to economics and recreation.					

Adhering to Laws and Regulations

Agricultural Resources
Outdoor Recreation

ISBE 41-78 (1/88)

Submission Date ______________
☐ **Original submission** ☐ **Revision**
Page ____ of ____

I. LEARNING AREA *(check one)*
☐ Language Arts ☐ Fine Arts
☐ Mathematics ☒ Social Sciences
☐ Sciences ☐ Physical Development/Health

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

(Affix label or complete district information.)

COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐

District Name

City

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will be able to apply the skills and knowledge gained in the social sciences to decision making in life situations.

Contact Person: ______________
Title: ______________
Phone: (   )

III. LEARNING OBJECTIVES	**IV. ASSESSMENT**				**V. EXPECTATIONS**
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Understand the knowledge and skills required for success in selected fields of work.					
*2. Recognize that competence in a field of work entails the development of a wide range of skills.					
3. Identify the most common boating law questions and provide answers for them.					
4. Distinguish between the three types of marine fire extinguishers.					
5. Discuss fire safety and prevention in the outdoors.					

Adhering to Laws and Regulations

ISBE 41-78 (1/88)

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Outdoor Recreation

PROBLEM AREA: Adhering to Laws and Regulations

STUDENT LEARNING OBJECTIVES

Upon completion of their study of this problem area, students will be able to:

1. Identify the most common boating law questions and provide answers for them.
2. List the U.S. Coast Guard minimum requirements for motor boats.
3. Describe the type and placement of boat lights.
4. Distinguish between the three types of marine fire extinguishers.
5. Describe the types of personal flotation devices.
6. Identify state waterway markers.
7. Formulate maximum horsepower and person capacity for boats.
8. Identify the effects of alcohol on a person's body and relate those effects to boating.
9. Identify the major causes of boating fatalities.
10. Identify snowmobile trail signs.
11. Correctly fill out a snowmobile accident report form.
12. Correctly register a snowmobile and correctly apply registration on snowmobile hood.
13. Discuss snowmobile safety.
14. Discuss fire safety and prevention in the outdoors.
15. Discuss camping safety.
16. Discuss safety related to 4-Wheeling and trail biking.
17. Plan for a safe backpacking trip.

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Outdoor Recreation

PROBLEM AREA: Adhering to Laws and Regulations

PROBLEMS AND QUESTIONS FOR STUDY

1. What are some questions you have related to safe boating?
2. What are the minimum safety requirements needed in a boat?
3. What types of lights are needed on a boat and where should they be placed?
4. Are all marine fire extinguishers the same?
5. How many types of personal flotation devices can you describe?
6. How do you know where you can safely travel when you are on a waterway or river?
7. How do you determine the maximum number of people that can safely travel in a boat?
8. Can alcohol affect the way a person operates a boat?
9. What are the major causes of boat fatalities?
10. Are there markers on snowmobile trails?
11. Should you file an accident report when you have a snowmobile accident?
12. Do snowmobiles need to be registered with the state?
13. How do you operate a snowmobile safely?
14. When we are in the outdoors, what can we do to aid in preventing fires?
15. How do you plan for a safe camping trip?
16. How do you plan for a safe backpacking trip?

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Outdoor Recreation

PROBLEM AREA: Adhering to Laws and Regulations

SUGGESTED TEACHING ACTIVITIES AND PROCEDURES

1. Visit a retail boat dealership. Have students select a boat and gather information for completing the boat buyer's guide. Discuss whether or not each boat met the required safety requirements.
2. Bring a snowmobile into the school. Have students examine the snowmobile and fill out the pre-season check list.
3. Have students fill out the snowmobiler experience survey. After completion of the survey, discuss snowmobile safety.
4. Assign each student an injury that could possibly occur on a snowmobile. Have each student fill out an Illinois accident report accordingly.
5. As a class, plan for a camping and/or backpacking trip. Cover all the aspects of proper planning and safety precautions. Assign each student specific duties in insuring a safe trip.
6. Have a Conservation Service Enforcement Official discuss with the class the local areas for recreation and the pertinent laws and regulations governing their use.
7. Obtain the appropriate pamphlets from the Illinois Department of Conservation as listed on the reference page for use as student resources and references to complete the student activities. These are available at the local Illinois Department of Conservation office or from the address given.

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Outdoor Recreation

PROBLEM AREA: Adhering to Laws and Regulations

REFERENCES

*1. *Illinois Boating Basics*. Illinois Department of Conservation, Division of Law Enforcement, 600 North Grand Avenue West, Springfield, IL 62706. (217) 782-6431.

2. *Illinois Boat Registration, Titling and Safety Act Digest*. Illinois Department of Conservation, Information and Education, Lincoln Towers, Suite 100, 524 South Second Street, Springfield, IL 62706. (217) 782-7454.

3. *Illinois Small Craft Handling*. Illinois Department of Conservation, Division of Law Enforcement, 600 North Grand Avenue West, Springfield, IL 62706. (217) 782-6431.

4. *Tips for Safe Boating*. Alcohol and Water Safety. Illinois Department of Conservation, Division of Law Enforcement, 600 North Grand Avenue West, Springfield, IL 62706. (217) 782-6431.

*5. *Snowmobile Safety and You*. Illinois Department of Conservation, Division of Law Enforcement 600 North Grand Avenue West, Springfield, IL 62706. (217) 782-6431.

*6. *Illinois Snowmobile Registration and Safety Act Digest*. Illinois Department of Conservation, Information and Education, Lincoln Towers, Suite 100, 524 South Second Street, Springfield, IL 62706. (217) 782-7454.

*7. *Fire Safety Outdoors*. United States Department of Agriculture, Forest Service, Shawnee National Forest, Highway 45, South, Harrisburg, IL 62946. (618) 253-7114.

8. *Woodsy Owl On Camping*. United States Department of Agriculture, Forest Service, Shawnee National Forest, Highway 45, South, Harrisburg, IL 62946. (618) 253-7114.

*9. *Woodsy Owl on 4-Wheeling and Trail Biking*. United States Department of Agriculture, Forest Service, Shawnee National Forest, Highway 45, South, Harrisburg, IL 62946. (618) 253-7114.

*10. *Woodsy Owl on Backpacking*. United States Department of Agriculture, Forest Service, Forest Service, Shawnee National Forest, Highway 45, South, Harrisburg, IL 62946. (618) 253-7114.

*Indicates highly recommended reference

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTIONAL RESOURCES

These resources are intended for use by teachers in planning and teaching the materials for this problem area and may be adapted to fit the teaching method(s) used.

INFORMATION SHEET #1 — The Most Common Boating Law Questions

INFORMATION SHEET #2 — Illinois Boat Registration, Titling and Safety Act

INFORMATION SHEET #3 — U.S. Coast Guard Minimum Requirements for Motorboats

INFORMATION SHEET #4 — Lighting Requirements for Boats

INFORMATION SHEET #5 — Alcohol's Effects on the Body

INFORMATION SHEET #6 — Illinois Snowmobile Registration and Safety Act Digest

INFORMATION SHEET #7 — Accident Reporting

INFORMATION SHEET #8 — Basic Snowmobile Safety Code

INFORMATION SHEET #9 — Fire Safety Outdoors

INFORMATION SHEET #10 — Camping Safety

INFORMATION SHEET #11 — Four-Wheeling and Trail Biking Safety

INFORMATION SHEET #12 — Backpacking Safety

TRANSPARENCY MASTER #1 — Marine Fire Extinguisher Classification

TRANSPARENCY MASTER #2 — Personal Flotation Devices

TRANSPARENCY MASTER #3 — Uniform State Waterway Marking System

TRANSPARENCY MASTER #4 — Boating Safety

TRANSPARENCY MASTER #5 — Determining Maximum Horsepower and Person Capacity for Boats

TRANSPARENCY MASTER #6 — Boating Fatalities Type of Accident

TRANSPARENCY MASTER #7 — Tips for Safe Boating

TRANSPARENCY MASTER #8 — Snowmobile Trail Signs

INFORMATION SHEET #1

The Most Common Boating Law Questions

1. Q: What about equipment regulations for motorboats?

   A: **Personal Flotation Devices (life preservers):** It is unlawful to operate any vessel unless at least one U.S. Coast Guard approved Type I, II, or III personal flotation device (PFD) is on board for each person. A Type V PFD, if approved for the activity, may be substituted for any of the above devices. In addition, any vessel 16 feet or more in length, except for a canoe or kayak, must also have a U.S. Coast Guard approved Type IV throwable device on board.

   When assisting a person on water skis, aquaplane or similar device, there must be one U.S. Coast Guard approved lifesaving device on board for each person being assisted or towed. Any such PFDs mentioned in this section must be readily accessible, in serviceable condition, of an appropriate size for the person for whom it is intended, and legibly marked with the U.S. Coast Guard approved number.

   Lights: It is unlawful to operate any vessel less than 26 feet in length unless the following lights are carried and displayed when underway from sunset to sunrise:

   1. A bright, white light aft to show all around the horizon, visible for a distance of two miles. The word "visible" as used herein means visible on a dark night with clear atmosphere.
   2. A combination light in the forepart of the boat lower than the white light aft, showing green to starboard and red to port, so fixed as to throw a light from dead ahead to two points abaft the beam on their respective sides and visible for a distance of not less than one mile.

   Lights under International Rules may be shown as an alternative to the above requirements.

   Every vessel 26 feet or more in length shall carry and display when underway such additional or alternate lights as shall be required by the U.S. Coast Guard for watercraft of equivalent length and type.

   Sailboats equipped with motors and being propelled partly or solely by such motors shall carry and display the same lights required for motorboats of the same class. Sailboats of less than 26 feet in length, equipped with motors but being propelled entirely by sail between sunset and sunrise, shall have lighted the combination running light, but not the white light aft. Sailboats 26 feet or more in length, equipped with motors but being propelled entirely by sail between sunset and sunrise, shall have lighted the colored side lights suitably screened, but not the white lights prescribed for motorboats.

   Vessels at anchor between the hours of sunset and sunrise, except those in a "Special Anchorage Area," shall display such anchor lights as shall be required by the U.S. Coast Guard for watercraft of equivalent length and type.

   Watercraft operated manually or by motor which are located on bodies of water where motors of over seven and a half horsepower are prohibited must be equipped during the hours between sunset and sunrise with a lantern or flashlight which is capable of showing a beam for two miles, anything in this Section to the contrary notwithstanding.

   Whistles: It is unlawful to operate a motorboat without a mouth, hand, or power operated whistle, horn, or other appliance capable of producing a blast of two seconds or more duration and audible for at least one half mile. This regulation applies to all motorboats, regardless of size or motor.

   Fire Extinguisher: It is unlawful to operate a motorboat equipped with an internal combustion engine anywhere in this State without at least one U.S. Coast Guard approved fire extinguisher so placed as to be readily accessible and in such condition as to be ready for immediate and effective use.

   Capacity Plates: Boats purchased after January 1, 1968 must have affixed permanently a manufacturer's capacity plate.

   Battery Covers: Storage batteries shall be provided with suitable supports and secured against shifting. Batteries shall be equipped with non-conductive shielding means to prevent accidental shorting.

2. Q: Are there regulations I need to follow when towing a water-skier?

   A: Yes. As mentioned above, when assisting a person on water skis, there must be one U.S. Coast Guard approved lifesaving device on board for each person being assisted or towed. The device must be readily accessible, in serviceable condition, of an appropriate size for those for whom it is intended, and marked with U.S. Coast Guard approval number.

   Also, when towing a person on water skis, at least two competent persons must be in the boat. It is unlawful to water-ski from the period of one-half hour after sunset to one-half hour prior to sunrise.

3. Q: Does my boat have to be registered and/or titled with the State?

   A: All boats intended for use on the waters of the State must be registered and titled with the State of Illinois, Department of Conservation before they can be legally operated on Illinois waters.

4. Q: How do I register and title my boat?

   A: To register and title your boat in Illinois, you must submit an application to the Department of Conservation on an official Watercraft Application. Forms are available from any Conservation Department Region Office or from any Illinois boat dealer.

5. Q: I received my Certificate of Number in the mail, but my title was not enclosed. When will I get my title?

   A: Your title is mailed separately from your Certificate of Number and you should receive it shortly. Your Certificate of Number is good for two years from the nearest June 30th date of application. Expiring Certificates of Number must be renewed before June 30th of the year of expiration. (*Your certificate of number card should be available for inspection any time your boat is in operation.*)

   When you receive your title, make sure to put it in a safe place.

   Make sure your Hull Identification Number corresponds with the Hull Identification Number on your title and Certificate of Number.

6. Q: Do I have to register my canoe if I put a trolling motor on it?

   A: Yes. As mentioned before, all boats must be registered and titled with the State of Illinois.

7. Q: What is required legally if my boat is involved in a collision or accident?

   A: Whenever a boat is involved in a collision or accident causing injury or death to persons or property damage of $200, a report must be made to the Department.

   All boating accidents which result in death or serious injury to any person shall be reported by the operator within 48 hours. All other accidents shall be reported within five days. The report will be confidential and without prejudice to the individual reporting. Forms for the reporting of accidents in the above categories may be obtained from your local Conservation Police Officer or from the Department.

8. Q: My son is nine years old. Can he operate our motorboat?

   A: No. No person under ten years of age may operate a motorboat.

   Persons 10 and 11 years old may operate a motorboat only if they are accompanied on the motorboat by, and are under the direct control of, a parent or guardian.

   Persons 12 through 17 years old may operate a motorboat only if they are accompanied on the motorboat by, and are under the direct control of, a parent or guardian, or a person at least 18 years of age designated by a parent or guardian; or such motorboat operator is in possession of a Boating Safety Certificate issued by the Department of Conservation, Division of Law Enforcement, authorizing the holder to operate motorboats.

9. Q: If I approach a sailboat when in my motorboat, who has the right-of-way?

A: The sailboat. When a motorboat approaches a boat propelled solely by sails or oars, the motorboat must yield the right-of-way to the sailboat or rowboat except, when a large craft is navigating in a confined channel, the large craft has the right-of-way over a boat propelled solely by oars or sails.

10. Q: Where can I obtain a complete copy of the boating laws and regulations for the State of Illinois?

A: You can obtain an "Illinois Boat Registration, Titling and Safety Act Digest" from any Department of Conservation Region Office or from your local Conservation Police Officer.

Illinois Department of Conservation, Division of Law Enforcement

INFORMATION SHEET #2

Illinois Boat Registration, Titling and Safety Act

Article 1. Definitions

Vessel or Watercraft means every description of watercraft, used or capable of being used as a means of transportation on water, except a seaplane on the water, innertube, air mattress or similar device, and boats used for concession rides in artificial bodies of water designed and used exclusively for such concessions.

Motorboat means any vessel propelled by machinery, whether or not such machinery is the principal source of propulsion.

Sailboat means any watercraft propelled by sail or canvas, including sailboards.

Waters of this State means any water within the jurisdiction of this State.

Application and Jurisdiction: The Department shall, for the purposes of this Act, have full and complete jurisdiction of all waters within the boundaries of the State of Illinois.

Article 2. Inspection

Agents of the Department of Conservation or other duly authorized police officers may board and inspect any watercraft at any time for the purpose of determining compliance with this act.

Article 3 & 3A. Registrations and Titling.

Boats which must be registered and titled: All watercraft operated on the waters within the jurisdiction of this state shall be registered and titled.

Boats exempted from registration and titling: Watercraft shall not be required to be registered and titled under this Act if it is:

1. A watercraft which has a valid marine document issued by the United States Coast Guard, provided the owner of any such vessel used upon the waters of this state for more than 60 days in any calendar year shall be required to comply with the registration requirements of this act.
2. Already covered by a number in full force and effect from another State, if such boat will not be used within this state for a period in excess of 60 consecutive days.
3. A sailboard.
4. A watercraft from a country other than the United States temporarily using the waters of this state.
5. A watercraft owned by the United States, a state or subdivision thereof, used solely for official purposes, and clearly identifiable.
6. A vessel used exclusively as a ship's lifeboat.
7. Motorboats while competing in any race previously arranged and announced, or if such boats be designed and intended solely for racing, while engaged in such navigation as is incidental to the tuning up of the boats and engines for the race. Testing of motorboats incidental to tuning up of the boats and engines for the race may be accomplished only after obtaining the permission of the local Conservation Officer.
8. Non-powered watercraft owned and operated on water completely impounded on land belonging to the owner of the watercraft. This does not apply to waters controlled by a club or association.

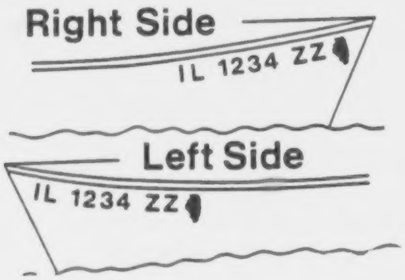
Watercraft exempt from titling: A watercraft covered by a valid marine document issued by the United States Coast Guard.

Registration-title application: The owner of each watercraft requiring registration and titling by this state shall file a watercraft application with the Department. The application shall be signed by the owner of the boat and shall be accompanied by the required documents (new boats: you must surrender the original properly endorsed Manufacturer's Certificate of Origin; boats previously registered or titled in another state: you must surrender the owner's registration certificate and/or title; Illinois titled boats: you must surrender the owner's Illinois title) and appropriate fee.

Warning: Boats purchased new or used from out of state dealers, manufacturers or lending institutions are subject to tax. You must contact the Illinois Department of Revenue at 1-800-635-4808 for instructions before submitting an application.

Title and registration card: The certificate of title shall be mailed to the lienholder or, if none, to the owner. The registration card shall be mailed to the owner, be pocket size and be available at all times for inspection on the boat for which issued, whenever such boat is in operation.

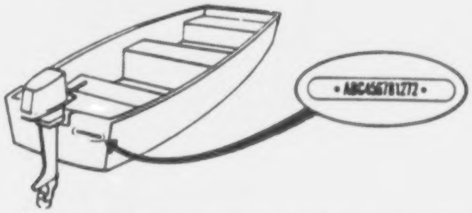
Registration number display: The owner shall paint on or attach to both sides of the bow (front) of the boat the registration number, which shall be of block characters at least three inches in height. The figures shall read from left to right, be of contrasting color to their background and be maintained in a legible condition. No other number shall be displayed on the bow. A space shall be provided between the IL and the number and another space between the number and the letters which follow. A vessel that is covered by a valid marine document is exempt from the requirement to display an Illinois registration number, but must display current expiration decals. Non-powered canoes and kayaks are not required to display registration numbers. Display decals only.



Hull Identification Number (HIN): Boats manufactured after 1972 will have a hull identification number consisting of 12 characters in one of the following three formats:

ABC456781273
ABC45678M73E
ABC45678A485

Article. Boat Equipment.



The Illinois Boat Registration and Safety Act provides that the following equipment will be provided in various classes of boats.

A. **Personal Flotation Devices (life preservers):** It is unlawful to operate any watercraft unless at least one U.S. Coast Guard approved PFD of the following types or their equivalent is on board for each person: Type I, Type II or Type III.

Any watercraft 16 feet or more in length, except a canoe or kayak, must have at least one Type IV U.S. Coast Guard approved PFD or its equivalent on board, in addition to the PFD's required above. When assisting a person on water skis, aquaplane, or similar device, there must be one U.S. Coast Guard approved PFD on board the watercraft for each person being assisted or towed, or worn by the person being assisted or towed. A U.S. Coast Guard approved Type V PFD may be carried in lieu of the Type I, II or III PFD, if the Type V PFD is approved for the activity in which it is being used.

All such PFD's mentioned in this section must be readily accessible, in serviceable condition, of an appropriate size for whom it is intended, and legibly marked with the U.S. Coast Guard approval number.

B. **Lights:** Every vessel shall carry and display when underway between the hours of sunset and sunrise such lights as shall be required by the United States Coast Guard for watercraft of equivalent length and type.

C. **Mufflers:** All motorboats except those actually competing in a race or regatta shall be equipped with an "adequate muffling" device.

D. **Whistles:** It is unlawful to operate a motorboat without a mouth, hand, or power operated whistle, horn, or other appliance capable of producing a blast of two seconds or more duration and audible for at least one half mile. This regulation applies to all motorboats, regardless of size of motor.

E. **Fire Extinguisher:** It is unlawful to operate any motorboat equipped with an internal combustion engine anywhere in this state without at least one U.S. Coast Guard approved fire extinguisher so placed as to be readily accessible and in such condition as to be ready for immediate and effective use.

F. **Carburetor Arrestors:** Except for outboard motors, all motorboats shall be fitted with a Coast Guard approved device for arresting backfire.

G. **Ventilators:** Except for open boats, all motorboats using fuel having a flashpoint of 110 degrees Fahrenheit or less shall have at least two ventilator ducts, fitted with cowls or their equivalent, for the efficient removal of explosive or flammable gases from the bilges of every engine and fuel tank compartment. There shall be at least one exhaust duct installed so as to extend from the open atmosphere to the lower portion of the bilge and at least one intake duct installed so as to extend to a point at least midway to the bilge or at least below the level of the carburetor air intake. The cowls shall be located and trimmed for maximum effectiveness and in such manner so as to prevent displaced fumes from being recirculated.

H. **Siren and Flashing Lights:** The use of sirens or flashing lights shall be unlawful except on duly designated patrol boats, and such sirens or flashing lights used in violation of the Boating Act shall be considered a public nuisance and subject to confiscation and disposal as determined by a competent court of jurisdiction.

I. **Capacity Plates:** Boats purchased after January 1, 1968 must have affixed permanently a manufacturer's capacity plate.

J. **Battery Covers:** Storage batteries shall be provided with suitable supports and secured against shifting. Batteries shall be equipped with nonconductive shielding means to prevent accidental shorting.

Article 5. Operation of Boats.

A. **Careless Operation:** No person shall operate any watercraft in a careless or heedless manner as to endanger any person or property, or at a rate of speed greater than will permit him in the exercise of reasonable care to bring the watercraft to a stop within the assured clear distance ahead.

B. **Reckless Operation:** No person shall operate any watercraft or manipulate any water skis, aquaplane, or similar device in such a manner as to willfully or wantonly endanger the life, limb or property of any person, or operate any watercraft so as to approach or pass another watercraft in such a manner or at such a rate of speed as to create a hazardous wake or wash.

C. **Sailboats and Rowboats:** When a motorboat is approaching a boat propelled solely by sails or oars, the motorboat must yield the right-of-way to the sailboat or rowboat except, when a large craft is navigating in a confined channel, the large craft has the right-of-way over a boat propelled solely by oars or sails.

D. **Restricted Areas:** No person shall operate a motorboat in a water area which has been clearly marked by buoys or signs as a bathing, fishing or otherwise restricted area, except in the manner prescribed by the buoys or signs marking the area. In areas designated as "No Wake" areas, no motorboat underway shall exceed five miles per hour while in the posted "No Wake" area.

E. **Water Skiing:** When towing a person on water skis, aquaplane or similar device, at least two competent persons must be in the boat. It is unlawful to water-ski from the period of one-half hour after sunset to one-half hour prior to sunrise.

F. **Diving:** No watercraft shall be operated within 150 feet of a diving flag, except for watercraft directly associated with the diving activity.

G. **Intoxication:** No person shall operate a watercraft while under the influence of alcohol or any other drug to the degree which renders them incapable of safely operating such watercraft. Persons arrested for this offense are required to submit to the same chemical tests as would be required for operation of motor vehicles while under the influence, at the arresting officer's direction. If a person refuses to submit to a test as requested by a law enforcement officer, his/her boating privileges may be suspended for a period of at least one year.

H. **Age of Operator:**

1. No person under ten years of age may operate a motorboat.

2. Persons at least ten years of age and less than 12 years of age may operate a motorboat only if:

    a. they are accompanied on the motorboat and under the direct control of a parent or guardian, or a person at least 18 years of age designated by a parent or guardian.

3. Persons at least 12 years of age and less than 18 years of age may operate a motorboat only if:

    a. they are accompanied on the motorboat and under the direct control of a parent or guardian, or

    b. a person at least 18 years of age designated by a parent or guardian, or

    c. such motorboat operator is in possession of a Boating Safety Certificate issued by the Department of Conservation, Division of Law Enforcement, authorizing the holder to operate motorboats.

4. Violations of this Section done with the knowledge of a parent or guardian shall be deemed a violation by the parent or guardian and punishable under Chp. 95 ½ Act. XI, Sec. 6 of the Illinois Boat Registration and Safety Act.

Article 6. Boat Accident Reports.

Whenever a boat is involved in a collision or accident causing injury or death to persons or property damage of $200, a report must be made to the Department.

All boating accidents which result in death or serious injury to any person shall be reported by the operator within 48 hours. All other accidents shall be reported within five days. The report will be confidential and without prejudice to the individual reporting. Forms for the reporting of accidents in the above categories may be obtained from your local Conservation Officer or from the Department.

Department of Conservation

INFORMATION SHEET #3

U.S. Coast Guard Minimum Requirements for Motorboats

Equipment	Class A (< 16 ft.) (< 4.9 m)	Class 1 (16 to < 26 ft.) (4.9 to < 7.9 m)	Class 2 (26 to < 40 ft.) (7.9 to < 12.2 m)	Class 3 (40 to not > 65 ft.) (12.2 to not > 19.8 m)
Back-fire flame arrestor	One approved device on each carburetor of all gasoline engines installed after April 25, 1940, except outboard motors.			
Ventilation Boats built before August 1, 1980	At least two ventilator ducts fitted with cowls or their equivalent for the purpose of properly and efficiently ventilating the bilges or every closed engine and fuel-tank compartment of boats constructed or decked over after April 25, 1940, using gasoline as fuel or other fuels having a flash-point of 110° or less.			
Ventilation Boats built on August 1, 1980, or later	At least two ventilator ducts for the purpose of efficiently ventilating every closed compartment that contains a gasoline engine and every closed compartment containing a gasoline tank, except those having permanently installed tanks which vent outside the boat and which contain no unprotected electrical devices. Also, engine compartments containing a gasoline engine having a cranking motor must contain power operated exhaust blowers which can be controlled from the instrument panel.			
Personal Flotation Devices (PFDs)	One approved Type I, II, III or IV PFD for each person on board or being towed on water skis, etc.	One approved Type I, II, or III device aboard for each person on board or being towed on water skis, etc.; and in addition, one throwable Type IV device. Note: Type V PFD may be carried in lieu of any wearable PFD, if approved for the activity in which the boat is being used. A Type V HYBRID must be worn to be legal.		
Bell, Whistle	Every vessel less than 12 meters (39.4 ft.) in length must carry an efficient sound-producing device.		Every vessel 12 meters (39.4 ft.) or larger in length must carry a whistle and a bell. The whistle must be audible for one-half nautical mile. The mouth of the bell must be at least 200 mm (7.87 inches) in diameter.	
Visual Distress Signals (Required on coastal waters only)	Must only carry approved visual distress signals for nighttime use.	Must carry visual distress signals approved for both daytime use and nighttime use. Note: All boats carrying six or more passengers for hire must meet these requirements also.		
Fire Extinguisher Must say Coast Guard Approved	At least one B-I type approved hand portable fire extinguisher. (Not required on outboard motorboats less than 26 feet in length and not carrying passengers for hire if the construction of such motorboats will not permit the entrapment of explosive or flammable gases or vapors and if fuel tanks are not permanently installed.)		At least two B-I type approved portable fire extinguishers; OR at least one B-II type approved portable fire extinguisher.	At least three B-I type approved portable fire extinguishers; OR at least one B-I type plus one B-II type approved portable fire extinguisher.

Note: When fixed fire extinguishing system is installed in machinery space(s) it will replace one B-I type portable fire extinguisher.

Illinois Department of Conservation

INFORMATION SHEET #4

Lighting Requirements for Boats

The lighting arrangements shown in the figures below have been taken from the *United States Coast Guard Navigation Rules, International-Inland (COM-DTINST M16672.2A)*, a book which is available from the Superintendent of Documents, United States Government Printing Office, Washington, DC 20402. Boats being used (or at anchor) between sunset and sunrise and in reduced visibility must display the lights required by these rules. Boats 12 meters or longer in length must carry a copy of the rules aboard.

The dividing lines (demarcation lines) between inland and international waters are described in the rule book. They are also shown on nautical charts of coastal waters.

Figure 1

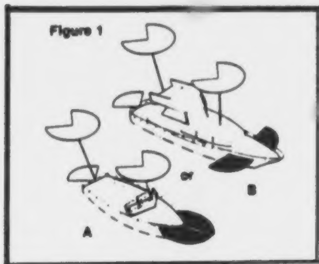


Figure 2

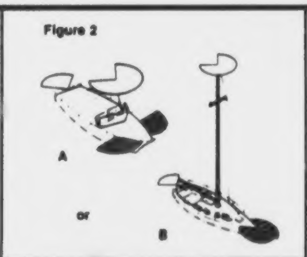


Figure 3

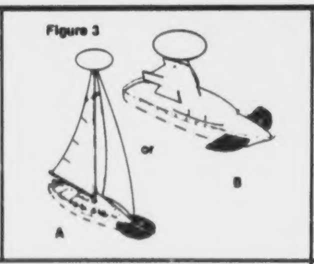


Figure 4

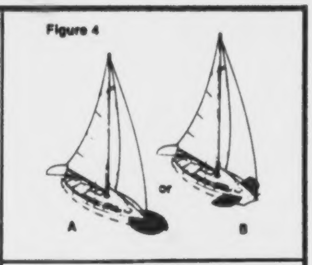


Figure 5

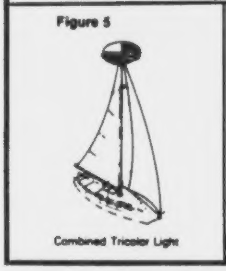
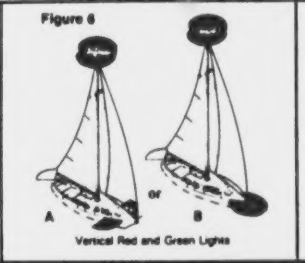
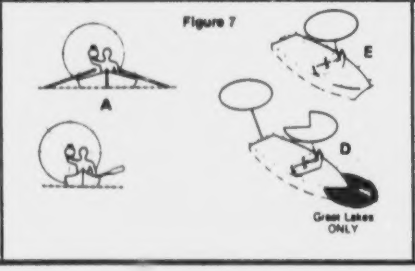

Combined Tricolor Light

Figure 6



Vertical Red and Green Lights

Figure 7



Great Lakes ONLY

Location of Lights on Vessel	Visible Range		Degrees of Arc Lights
	Less than 12m.	12m but less than 20m.	
	(in miles)		
Masthead	2	3	225°
All-round	2	2	360°
Side lights	1	2	112.5° each color
Stern light	2	2	135°

Lights Required on Boats Less Than 20 Meters in Length
Inland and International Waters

Boats Less Than 12 Meters in Length

Motorboat or Sailboat Using Power: the lighting arrangement in Figure 1, 2, or 3 may be used.

Sailboat Using Sails Alone: the lighting arrangement in Figure 4, 5, or 6 may be used.

Boats 12 Meters But Less Than 20 Meters in Length

Motorboat or Sailboat Using Power: the lighting arrangement in Figure 1 or 2 may be used.

Sailboat Using Sails Alone: the lighting arrangement in Figure 4, 5, or 6 may be used.

Rowing or Paddle Boat

One all-round white light ready to display in time to prevent a collision (Figure 7, A or B).

Boat at Anchor

One all-round white light (Figure 7, E). Anchor lights are not required when anchored in Special Anchorage Areas (inland waters only). Boats less than seven meters in length are not required to display anchor lights unless anchored in or near a channel, in an anchorage or near other vessels.

Exceptions

Motorboat or Sailboat Using Power, Built Before December 24, 1980: the lighting arrangement in Figure 1, 2, or 3 may be used. However, the arrangement in Figure 3 is not acceptable on a boat that is 12 meters or longer in length on international waters.

Motorboat or Sailboat Using Power on Great Lakes: the lighting arrangement in Figure 7, D may be used instead of the arrangements in Figures 1 and 2.

Locations of Lights

Lights should be located as shown in the above drawings.

The masthead light (forward white light in Figures 1, 2, and 7, D) must be at least one meter higher than the colored lights on a boat less than 12 meters in length and at least 2.5 meters above the gunwale on a boat 12 meters but less than 20 meters in length. The after masthead light (Figure 1 only), if used, must be higher than the forward masthead light so as to be seen as a separate, distinct light at a distance of 1,000 meters (about 1,093 yards) ahead of the boat.

The all-round white lights shown in Figures 3 and 7, D must be one meter higher than the colored lights.

An anchor light (Figure 7, E) must be displayed where it can best be seen.

Conversions

1 Meter = 3'4", 7 Meters = 23', 12 Meters = 39'5", 20 Meters = 65'7".

Illinois Department of Conservation

INFORMATION SHEET #5

Alcohol's Effects on the Body

Most states define impairment at .10 percent Blood Alcohol Content. However, any level of blood alcohol may affect a person's balance, vision, or judgment. This can be especially dangerous when on the water.

Balance

Alcohol impacts an individual's sense of balance. A moment of dizziness or even a mis-step may not cause any harm on your patio or in a restaurant, but it can lead to disaster on the water.

Vision

Safe boating requires good vision and any alcohol can seriously restrict your vision. It can create a "tunnel vision" effect, reducing peripheral vision. It impairs your ability to "focus" on objects, and it reduces your night vision. Especially for reds and greens . . . the colors of running lights.

Boating, Alcohol, and Safety

Operating a boat is at least as complicated as driving a car and a boating accident can be just as dangerous as an automobile accident. Yet many people who would never drive while drinking think it's safe to operate their boat after drinking. It isn't. In fact, 50 percent of all boating fatalities are alcohol-related. Operating a boat while drinking is illegal and dangerous.

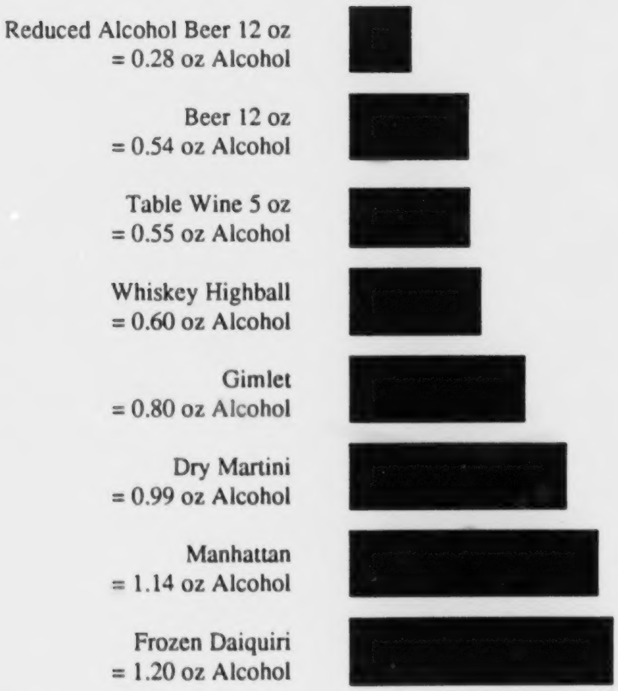
Alcohol Facts

The helmsman should not drink. A responsible boat owner will never allow a person under the influence to operate the boat.

Alcohol affects your judgment. It makes you think you can function better than when you are sober. But in fact, alcohol slows your reaction time considerably.

Hard liquor may hit a little harder or faster than beer or wine—especially if it is not diluted . . . but any beer or wine can be just as bad as any hard liquor.

Images can be deceiving. A daiquiri can have more than twice the alcohol of a beer or a whiskey and soda.



Adpated from: Illinois Department of Conservation

INFORMATION SHEET #6

Illinois Snowmobile Registration and Safety Act Digest

Article 1. Definitions

Snowmobile — "Snowmobile" means a self propelled device designed for travel on snow or ice or natural terrain, steered by skis or runners, and supported in part by skis, belts, or cleats.

Operate — "Operate" means to ride in or on, other than as a passenger, use or control the operations of a snowmobile in any manner, whether or not the snowmobile is under way.

Highway — "Highway" means the entire width between the boundary lines of every way publicly maintained when any part thereof is open to the use of the public for purposes of vehicular travel.

Roadway — "Roadway" means that portion of a highway improved, designed, or ordinarily used for vehicular travel, enclosure of the berm or shoulder.

Cowling — "Cowling" means the forward portions of a snowmobile surrounding the clutch and motor assembly.

Article 2. Inspection

Agents of the Department of Conservation or other duly authorized police officers may stop and inspect any snowmobile at any time for the purpose of determining if the provisions of this Act are being complied with.

Article 3. Registration

Operation of Unnumbered Snowmobiles. Except as hereinafter provided, no person shall, after the effective date of this Act, operate any snowmobile within this state unless such snowmobile has been registered and numbered in accordance with the provisions of this Article, and unless the certificate of number awarded to such snowmobile is in full force and effect.

Exception from Number Provisions of this Act. A snowmobile shall not be required to be numbered under this Act if it is:

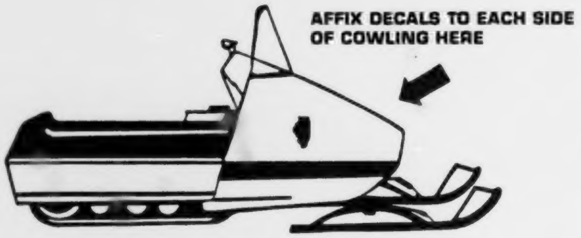
A. Owned and used by the United States, another state, or a political subdivision thereof, but such snowmobiles shall display the name of the owner on the cowling thereof.

B. Covered by a valid registration or license of another state, province or country *which is the domicile of the owner of the snowmobile* and is not operated within this state on more than 30 consecutive days in any calendar year.

C. Owned and operated on lands owned by the owner or operator or on lands to which he has a contractual right other than as a member of a club or association, provided the snowmobile is not operated elsewhere within the state.

Identification Number Application. The owner of each snowmobile requiring numbering by this state shall file a snowmobile application with the Department. This application shall be signed by the owner of the snowmobile and shall be accompanied by the required documents and appropriate fee.

Identification Number Display. The Department shall issue to the snowmobile owner two registration expiration decals with the number awarded to that snowmobile imprinted upon the decals. The owner shall apply these decals on each side of the cowling of such snowmobile. The certificate of number shall be pocket size and shall be available at all times for inspection on the snowmobile for which issued, whenever such snowmobile is in operation.


AFFIX DECALS TO EACH SIDE OF COWLING HERE

Article 4. Snowmobile Equipment

All snowmobiles operating within the State of Illinois shall be equipped with:

A. At least one white head-lamp having a minimum candlepower of sufficient intensity to exhibit a white light plainly visible from a distance of at least 500 feet ahead during hours of darkness under normal atmospheric conditions.

B. At least one red tail lamp having a minimum candlepower of sufficient intensity to exhibit a red light plainly visible from a distance of 500 feet to the rear during hours of darkness under normal atmospheric conditions.

C. A brake system in good mechanical condition.

D. Reflective material of a minimum area of 16 square inches mounted on each side of the cowling. Identifying numbers may be included in computing the required 16 square inch area.

E. Adequate sound suppression equipment. No snowmobile manufactured after June 1, 1972, shall be sold or offered for sale, unless it is equipped with sound suppression devices that limit total machine noise in accordance with noise pollution standards established pursuant to the Environmental Protection Act, Chapter 111 ½, 1101 et seq.

Article 5. Control Provisions

Operation Generally. It is unlawful for any person to drive or operate any snowmobile in the following ways:

A. At a rate of speed too fast for conditions and the fact that the speed of the snowmobile does not exceed the applicable maximum speed limit allowed does not relieve the driver from the duty to decrease speed as may be necessary to avoid colliding with any person or vehicle or object within legal requirements and the duty of all persons to use due care.

B. In a careless, reckless or negligent manner.

C. While under the influence of intoxicating beverages or narcotic or dangerous drugs.

D. At any time without at least one lighted headlamp and one lighted tail lamp on the snowmobile.

E. Within any nature preserve.

F. On the tracks or right of way of an operating railroad.

Operation on Highways. It is unlawful for any person to drive or operate any snowmobile on a highway in this state except as follows:

A. On highways other than tollways, interstate highways and fully or limited access-controlled highways snowmobiles may make a direct crossing provided:

1. The crossing is made at an angle of approximately 90 degrees to the direction of the highway and at a place where no obstruction prevents a quick and safe crossing; and

2. The snowmobile is brought to a complete stop before crossing a roadway; and

3. The operator yields the right of way to all oncoming traffic which constitutes a hazard.

B. On highways other than tollways, interstate highways and fully or limited access-controlled highways, snowmobiles may be operated not less than ten feet from the roadway and in the same direction as traffic. On such highways, other than State highways, the corporate authorities of a city, village or incorporated town may adopt ordinances providing for variance from the ten foot separation requirement of this subsection within city, village or town limits. Corporate authorities of a city, village or incorporated town may adopt ordinances providing for trails and regulating snowmobile operation within city, village or town limits.

C. On highways other than tollways, interstate highways and fully or limited access-controlled highways snowmobiles may be operated on roadways when it is necessary to cross a bridge or culvert or when it is impracticable to gain immediate access to an area adjacent to a highway where a snowmobile is to be operated.

D. Corporate authorities of a city, village or incorporated town may by ordinance designate one or more specific public highways or streets within their jurisdiction as egress and ingress routes for the use of snowmobiles. In the event that such public highways or streets are under the jurisdiction of the State of Illinois, expressed written consent of the Illinois Department of Transportation shall be required. Corporate authorities acting under the authority of this paragraph D shall erect and maintain signs giving proper notice thereof. (This section effective April 1, 1982.)

E. Snowmobiles may be lawfully driven or operated upon those highways where posted by the township road commissioner in townships with a population of less than 5,000 inhabitants. For purposes of this paragraph E, "highways" are defined as township roads pursuant to Section 2-205 of the Illinois Highway Code. (This section effective January 1, 1982.)

F. Youthful Operators:

1. No person under ten years of age may operate a snowmobile.

2. Persons at least ten and less than 12 years of age may operate a snowmobile only if:

a. they are either accompanied on the snowmobile by a parent or guardian or a person at least 18 years of age designated by a parent or guardian.

3. Persons at least 12 and less than 16 years of age may operate a snowmobile only if:

   a. they are accompanied on the snowmobile by a parent or guardian, or

   b. a person at least 16 years of age designated by a parent or guardian, or

   c. such snowmobile operator is in possession of a Snowmobile Safety Certificate issued by the Department of Conservation, Division of Law Enforcement, authorizing the holder to operate snowmobiles.

4. Any person who operates a snowmobile on a highway as provided in Section 5-2 shall (a) possess a valid motor vehicle driver's license; or (b) possess a safety certificate as provided for in this Section. Any such person less than 16 years of age shall also be under the immediate supervision of a parent or guardian or a person at least 18 years of age designated by the parent or guardian.

5. Violations of this Section done with the knowledge of a parent or guardian shall be deemed a violation by the parent or guardian and punishable under Article X of this Act.

Article 6. Accident Reports

A. The operator of a snowmobile involved in a collision, accident, or other casualty, shall render to other persons affected by this collision, accident, or other casualty such assistance as may be practicable and as may be necessary in order to save them from or minimize any danger caused by the collision, accident, or other casualty, and also shall give his name, address, and identification of his snowmobile to any person injured and to the owner of any property damaged in the collision, accident, or other casualty.

B. In the case of collision, accident, or other casualty involving a snowmobile, the operator thereof, if the collision, accident or other casualty results in death or injury to a person or damage to property in excess of $100, shall file with the Department a full description of the collision, accident, or other casualty, including such information as the Department may, by regulation, require. Reports of such accidents must be filed with the Department on a Department Accident Report form within five days.

C. Reports of accidents resulting in personal injury wherein a person is incapacitated for a period exceeding 72 hours, must be filed with the Department on a Department Accident Report form within five days. Accidents which result in loss of life shall be reported to the Department on a Department form within 48 hours.

Article 9. Special Fund

Snowmobile Trail Establishment Fund. Effective April 1, 1982, the Snowmobile Registration and Safety Act was amended so that $2.00 of each new, transfer-renewal and renewal registration fee shall be deposited in this fund and shall be used for disbursement, upon written application to and subsequent approval by the Department, to nonprofit snowmobile clubs and organizations for construction, maintenance and rehabilitation of snowmobile trails and areas for the use of snowmobiles.

Illinois Department of Conservation

INFORMATION SHEET #7

Accident Reporting

Accident reports are helpful in identifying why the accident occurred. The accident may be due to a local environment condition, hazardous trail condition, or a manufacturing error. Once the cause of the problem is known, a solution can be found.

The operator of every snowmobile involved is required by the Illinois Snowmobile Registration and Safety Act of 1971 to file a report in writing whenever a snowmobile accident results in loss of life, injury causing incapacitation in excess of 72 hours or property damage in excess of $100. Reports in death cases must be submitted within 48 hours; reports in other cases are required within five days. If the operator is physically incapable of making such reports, then the owner shall make the report. Failure to comply with these requirements shall constitute an offense punishable by fine. Send your completed report to Illinois Conservation - Law Enforcement.

Illinois Accident Report Form

1. Time and Place of Accident				
A. Date of Accident	B. Time AM PM	C. State	D. Nearest City, Town, Etc.	E. County
F. Exact Location *(Name of trail or area, fix location precisely)*		G. Type of Terrain		
		☐ 1. Woods ☐ 2. Field	☐ 3. Trail	☐ 4. Roadway

2. Data *(Check all appropriate items in box to left of number or fill in)*			
A. Name & Address of Operator	B. Operator's Age	C. Operator's Experience	
		☐ 1. < 20 hours	☐ 3. 100 to 500 hrs
		☐ 2. 20 to 100 hours	☐ 4. > 500 hours
D. Name & Address of Owner	5. Have you had formal instruction in snowmobiling?		
	6. Operator's Certificate No.		
	E. Snowmobile Track		
	☐ 1. Rubber	☐ 3. Bogie Wheels	☐ 5. Width of Track
	☐ 2. Rubber & Steel Cleats	☐ 4. Slide Suspension	

F. Snowmobile		G. Propulsion		
Make	1. Length Ft.	☐ 1. 1 Cylinder	☐ 4. Other	6. Total Horsepower
Weight	2. Width Ft.	☐ 2. 2 Cylinders	☐ 5. C.C.	
Model	3. Year Built	☐ 3. 3 Cylinders		

3. Weather and Snow Conditions *(Check all appropriate items in box to left of number)*					
A. Weather		B. Visibility	C. Snow	D. Wind	
☐ 1. Clear	☐ 4. Snow	☐ 1. Good	☐ 1. Smooth	☐ 1. None	☐ 4. Strong
☐ 2. Fog	☐ 5. Other *(Specify)*	☐ 2. Fair	☐ 2. Rough	☐ 2. Light	
☐ 3. Rain		☐ 3. Poor	☐ 3. None	☐ 3. Moderate	☐ 5. Storm

4. Operation at Time of Accident *(Check all appropriate items in box to left of number or fill in)*					
A. Underway			B. Not Underway		C. Number of Persons on Snowmobile *(Specify)*
☐ 1. Cruising	☐ 3. Towing Sled	☐ 6. Racing	☐ 1. Attended	☐ 4. Other *(Specify)*	
☐ 2. Manuevering	☐ 4. Towing *(Other)*	☐ 7. Other *(Specify)*	☐ 2. Parked		
	☐ 5. Being Towed		☐ 3. Fueling		

5. Type, Nature or Classification of Accident *(Check all appropriate items in box to left of number or fill in)*					
Snowmobile Casualty					
☐ 1. Overturning	☐ 3. Collision with Person	☐ 5. Fire or Explosion (Fuel)	☐ 7. Collision with Another Snowmobile	☐ 9. Struck Hidden Object in Snow	☐ 11. Other *(Specify)*
☐ 2. Skidding	☐ 4. Collision with Motor Vehicle	☐ 6. Fire or Explosion (Other than Fuel)	☐ 8. Collision with a Fixed Object	☐ 10. Disappearance of Snowmobile	

B. Death		C. Personal Injuries				D. Property Damage		
No.	Cause	No.	Cause	No.	Cause	Item Damaged	This Vessel	Other
	1.		1. Fell Off		5. Struck by other snowmobile	1. Snowmobile	$	$
	2.		2. Track Injury		6. Other *(Specify)*	2. Accessory Equipment	$	$
	3.		3. Burns or Scalds			3. Damage to Other Property		
			4. Crushed or Pinched			*(Describe on reverse)*		$

Give a brief but clear description of the accident, use additional sheets if necessary.

What , in your opinion, caused the accident?

7. Lives Lost	8. Persons Injured
A. List names & Addresses	A List Names, Addresses: Nature and Extent of Injury

9. Property Damage

Describe Property Damaged, Include Name & Address of Owner:

10. Witnesses	11. Assistance Furnished
A. List Names & Addresses of All Known Witnesses	A. List Known Police Fire Dept., Rescue Squads, Etc.

12. Persons on Snowmobile *(Other than operator)*

Name Address Age

Name Address Age

Name Address Age

13. Remarks: *(include opinion how similar accidents can be prevented or avoided in the future)*

14. Name, address of operator and registration number of other vehicles involved.

I declare under the penalties of perjury that to the best of my knowledge and belief, the description and statements made herein are true and correct.

Operator's Signature Telepone Number

(Complete all applicable sections or forms will be returned)

Illinois Department of Conservation
Agricultural Resources
Outdoor Recreation

INFORMATION SHEET #8

Basic Snowmobile Safety Code

What you've learned will help you become a safe snowmobiler. We have provided information about your snowmobile, its operation, maintenance, and equipment. You should have developed the ability to better handle yourself in emergency situations. Know and practice this "Basic Snowmobile Safety Code."

1. Be sure your snowmobile is in top-notch mechanical condition at the beginning of the winter season and through the months of use.
2. Familiarize yourself with the snowmobile you are driving by reading in detail the manual accompanying the snowmobile.
3. Wear sensible, protective clothing designed for snowmobiling.
4. Use a full-size helmet, goggles, or face shield to prevent injuries from twigs, stones, ice chips, and flying debris.
5. Avoid wearing long scarves. They may get caught in moving parts of the snowmobile.
6. Know the terrain you are going to ride. If unfamiliar to you, ask someone who has traveled over it before.
7. Know the weather forecast and especially the ice and snow conditions in the area.

8. Always use the buddy system. Never ride off alone or unaccompanied.
9. Do not pursue domestic or wild animals. No true sportsperson would stoop to such conduct. If you see a violation of this rule, report it to the nearest law enforcement officer.
10. At all times, be sure you have a properly operating lighting system on the snowmobile.
11. Drowning is one cause of snowmobile fatalities. When not familiar with the thickness of the ice or water currents, avoid these areas.
12. Don't remove the factory-installed air box or muffler to install one that makes more noise. This would lessen the performance of your vehicle. The manufacturer is trying hard, for the betterment of the environment, to develop a quieter machine.

871

INFORMATION SHEET #9

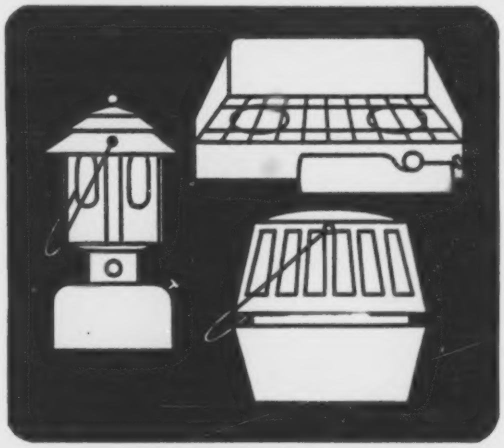
Fire Safety Outdoors

Lanterns, Stoves, and Heaters

Gasoline lanterns, stoves, and heaters should be allowed to cool off prior to filling. Then place them on the ground in a cleared area and fill. If you have spilled any liquid, move stove or lantern to a new clearing before lighting. Recap and store flammable liquid container in a safe place. Never light lanterns and stoves inside a tent, trailer, or camper.

When you must use the lantern or stove inside a tent or trailer, be sure you have adequate ventilation.

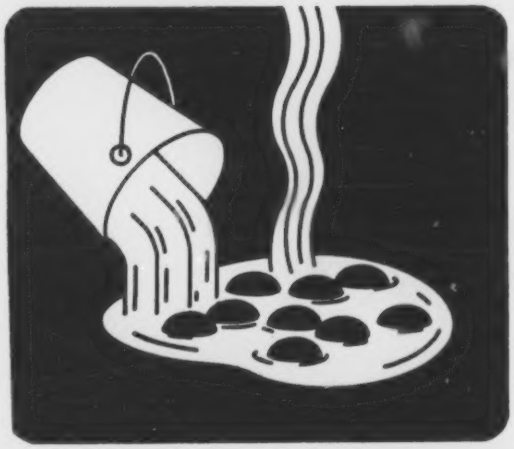
Always read and follow directions provided by the manufacturer.



Charcoal Briquets

When you finish using the burning charcoal briquets:

1. Dunk 'em! Don't sprinkle.
2. Soak coals with lots of water.
3. Stir coals and soak again.
4. Be sure they are out—cold!
5. Carefully feel coals with your bare hands to be sure.
6. Do not just bury your coals; they can smolder and break out and start a wildfire.



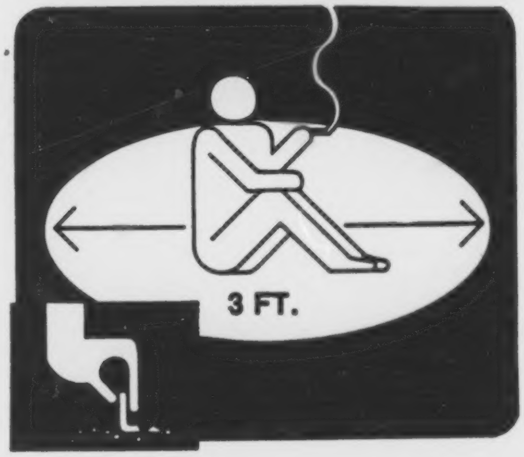
Smoking

When smoking is not prohibited, safe fire practices require at least a three-foot clearing around where you are sitting.

Be sure your match is out. Hold it until charred portion is cold. Break it before discarding.

Be sure you grind out your cigarette, cigar, or pipe tobacco in the dirt where you are sitting. Never grind it on a stump or log.

It is an unsafe fire practice to smoke while walking or riding a horse or a trail bike. While in your car, always use your ash tray.



872

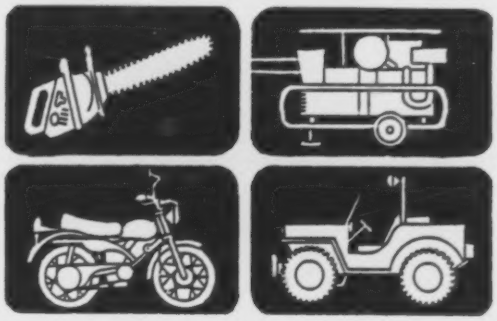
A Faulty Spark Arrester Can Start a Wildfire

All types of vehicles and equipment need spark arresters. Chain saws, motorcycles, cross country vehicles, portable generators, and trail bikes require them if you use them in or near grass, brush, or forest areas.

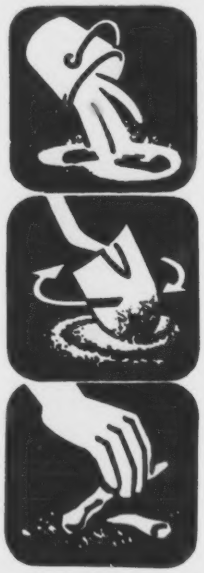
Be sure you have the proper spark arresters. If you are not sure what kind is correct for your vehicle, ask someone who knows. Check with the company that sold you your vehicle. Or contact your local office of the Forest Service, State Forester, or Bureau of Land Management.

Be sure your spark arrester is working correctly. Always check it before heading into a grass, brush, or forest area. If you are not sure about the condition of your spark arrester, take your vehicle to someone who knows what kind of trouble to look for.

Remember, a little extra care only takes a few minutes of your time. And it could prevent a wildfire.



How to Be Sure Your Campfire is Out!



1. Drown it with water. Make sure all embers, coals, and sticks are wet. Move rocks; there may be burning embers underneath.
2. Stir. Add more water and stir again. Be sure all burning material has been extinguished and cooled.
3. Feel all sticks and charred material. Feel the coals and ashes. Make sure no roots are burning.

No water? Use dirt. Mix enough soil or sand with embers and the fire will go out. Continue adding and stirring until all material is cold enough to feel with your bare hand. (Don't just bury it—it may smolder and break out again!)

December 1974

Approved for reprinting October 1986

United States Department of Agriculture
Forestry Service

INFORMATION SHEET #10

Camping Safety

So, you are going camping! Fine! Here are a few tips to help make your trip more enjoyable.

1. Plan Ahead

   Find out as much as you can about the area where you will be camping. Obtain maps if possible. Know campground locations and types of camping accommodated (tents, campers, trailers). Make reservations or have an alternative plan. Find out what facilities (water, toilets, fireplace, etc.) are provided. This will help in planning what to take.

2. At the Campground

   Select a site. Consider: privacy afforded, distance from facilities, and ease of entry and exit. If using a tent, look for a level, well-drained site. Bring tent poles and pegs, also foam pads or air mattresses. Cutting trees, shrubs, or branches is forbidden at most campgrounds. Check bulletin boards for rules and procedures.

3. Campground Courtesy

   Respect the rights and privacy of other campers. Place trash in receptacles or take it out with you. Avoid making loud noises at night. Treat signs, tables, and other facilities as if they were your own. Leave your campsite the way you would like to find it.

4. Keep the Water Supply Clean

   Carry water used for washing yourself or your dishes away from the source of drinking water. Dispose of soapy water, grease, and other waste away from lakes, springs, or streams. Boil drinking water unless you are certain it is safe. Use toilets provided and help keep them clean.

5. Help Preserve Soil and Plants

   Use only designated paths and trails. Leave wildflowers for others to enjoy. You may dig holes if permitted, but in such cases, before leaving be sure to replace the soil and sod, then tamp the spot well. Avoid disturbing soil in fragile areas such as stream banks or mountain meadows.

6. Food Preparation and Storage

   Use of a portable stove can be invaluable on a camping trip. If you use firewood or charcoal for cooking, you may have to carry them with you, since wood is not always available at campsites. Use the fireplaces provided. Do not leave any fire unattended. Put fires out by soaking with water and stirring with a stick, trowel, or other tool.

   Do not leave food out while away from camp. Keep all foodstuffs together and store in a safe place. In bear country, put food in a car or other vehicle.

7. Accidents Can Ruin Your Trip

   Guard against them! Familiarize yourself with hazards of the area such as poisonous snakes, plants, and insects; rockslides; or dangerous animals. Know how to cope with them. Keep small children from wandering away unattended.

8. Mishaps Do Happen

   Know what to do if one should occur. Carry a first aid kit and know how to use it. Know how to get in touch with police, park, or forest rangers, or others who can help in an emergency.

9. Leave Your Trip Plan

   Notify a neighbor, friend, or member of your family of your planned travel route. Should your plans change, be sure to let someone know. Be sure someone knows how to get in touch with you should it become necessary.

874

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INFORMATION SHEET #11

Four-Wheeling and Trail Biking Safety

Here are a few tips to make your four-wheeler or trail bike outing more enjoyable.

1. Where Will You Ride?

   Choose well your places to ride. Before you go out, check on available trails, their condition, ownership of land, posted areas, and regulations that apply. Ask about barriers such as fences, rivers, cliffs, or swamps; where rivers can be crossed and routes around swamps or cliffs. Get maps and learn how to use them. Power lines, strip mines, old railroad rights-of-way, and logging roads are possible places to ride. Forest or park rangers, sheriffs' offices, sportsmen's clubs, other trailbikers and 4-wheelers are good sources of information.

2. Check Your Equipment

   Make sure your machine is right for the terrain and conditions. Do you have the right tires? Is your exhaust system adequate? If riding in a forested area, do you have an approved spark arrestor? Take along tools and spare parts for minor repairs. Bikers should have sparkplugs, control cables, chain links, and a tire repair kit. Four-wheelers will want sparkplugs, gas, oil, radiator water, jack, tire repair kit, hoses, belts, and cable clamps for their winches.

3. Check Your Clothing

   Choose clothing for safety and comfort. Bikers should have sturdy but comfortable helmet, goggles, gloves, and boots. Other clothing should be appropriate to the weather and provide protection against brush and possible spills. Four-wheelers should dress for the weather and carry foul weather gear plus sturdy leather or leather-palmed gloves for handling the winch cable.

4. Haul It In - Haul It Out

   Littering the landscape where you ride invites land and trail closures. If you haul it in, you can haul it out. Go one step further and haul out what less thoughtful persons have left.

5. Be Courteous and Considerate

   At times, you will share the same space with hikers, horseback riders, hunters, fishermen, and others who enjoy the outdoors. Courtesy and consideration will make the sharing more tolerable for all. Respect the land and rights of others. Be sure your machine is as quiet as you can make it. Leave fences and gates as you find them. Assist others who need help. Courtesy is catching. Pass it on.

6. Let Someone Know

   Riding with a companion or companions adds to the enjoyment and makes good sense from a safety standpoint. Whether riding with someone or not, always let someone else know where you are going and when you expect to return. If headed for backcountry, leave your trip plan with someone who can take action if you don't return as planned—for instance, a forest or park ranger, a sheriff's office, or a local 4-wheel drive or trail bike club.

7. Be Prepared for Emergencies

   Emergencies don't always happen to the other person. Having spare parts, tools, and adequate clothing will help. But, for safety's sake, take a first aid kit, fire extinguisher, drinking water, flashlight, matches, blankets, and flares.

8. When You Ride

   Let your passing be as unnoticeable as possible. Follow all regulations. Stay on roads and trails designated for such use. Avoid cutting across switchbacks or through mountain meadows. Don't spin wheels unnecessarily. Avoid driving in streams or on steep hills with loose soil. Don't harass livestock or wildlife. Leave natural and historical features as you find them.

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Forestry Service

INFORMATION SHEET #12

Backpacking Safety

Here are a few tips to make your backpacking trip more enjoyable.

1. Plan Your Trip

   Before your hike, study maps of the area, get permits if necessary, and learn the terrain. Be familiar with all options—time, alternative routes, and weather. Keep in mind the shorter daylight hours of fall and winter.

2. Limit the Size of Your Group

   Limit your group to a size a leader can safely handle and that won't damage back country sites. One leader for eight hikers is recommended.

3. Help Preserve Nature's Ground Cover

   Bring tent poles and ground pad. Help keep the natural beauty by not cutting boughs and poles. Pick a camping site where you won't need to clear vegetation or ditch around your tent. Remember even minor use can damage a boggy meadow.

4. Pack It In - Pack It Out

   If you can carry it in, you can carry it out. Go one step further and carry out trash that less thoughtful people have left behind.

5. Use a Portable Stove

   Many popular areas do not have enough wood for every camper to have a wood fire. Follow the stove manufacturer's instructions for safe operation.

6. Carry Extras

   Carry extra warm clothing such as windbreakers, wool jackets, hats, and gloves. Keep extra high-energy foods like hard candies, chocolate, dried fruits, or liquids accessible. Don't overload yourself—but be prepared for emergencies.

7. Insurance Items are a Must

   Travel with a first aid kit, map, compass, whistle, and guidebook. Know how to use them.

8. Tell Others Where You are Going

   Always leave your trip plan with a member of your family or a close friend.

9. Mishaps are Rare, But —

   They do happen. Should one occur, remain calm. In case of an accident, someone should stay with the injured person. Notify the nearest state, local, or federal law enforcement office for aid.

   If you become lost, stay where you are and keep warm. If a group member becomes lost, remember a description of how the person was dressed, and the time and location where the person was last seen.

10. If You Must Have a Campfire

    Keep it safe and small! Shelter your fire from high winds and keep away from logs, brush, and tree trunks. Clear the ground to mineral soil. Make sure it is DEAD OUT before leaving. Be sure you have necessary permits.

11. Keep the Water Supply Clean

    Please don't wash in it. Wash dishes and yourself away from and below all sources of drinking water. Dispose of waste water away from lakes, streams, and springs. Boil or treat water before drinking it.

12. Disposing of Human Waste

    Stay at least 100 feet from any water. Dig a small hole about eight inches deep. Cover it with loose soil and sod after using.

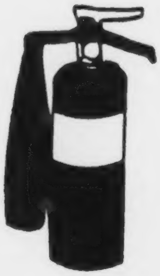
United States Department of Agriculture
Forestry Service

TRANSPARENCY MASTER #1

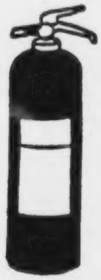
Marine Fire Extinguisher Classification

Coast Guard Classes	UL Listing	Foam (Gals.)	Co_2 (Lbs.)	Dry Chem. (Lbs.)	Halon (Lbs.)
B - I	5B	1.25	4	2	2.5
B - II	(6B*)	2.5	15	10	10
—	10B	none	10	2.5	5
—	20B	2.5	50	4.5-6	13

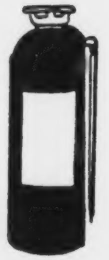
*UL rating 6B is no longer issued.



1. CO_2 or Halon/Freon



2. Dry Chemical



3. Foam

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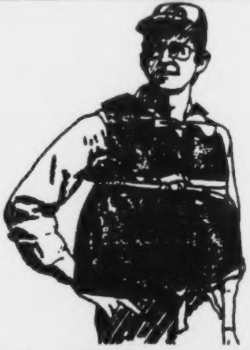
877

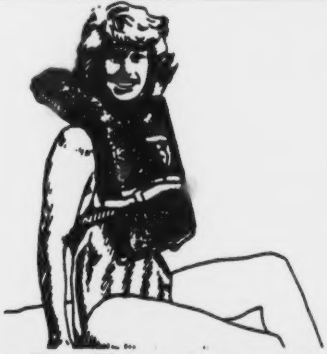
TRANSPARENCY MASTER #2

Personal Flotation Devices



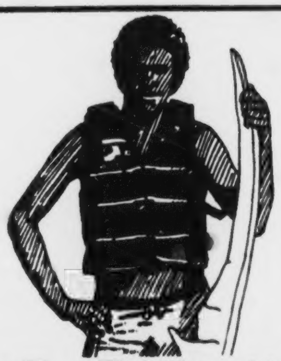
Type I — Offshore jacket

22 pounds flotation. Will turn an unconscious person face up. Acceptable on all recreational boats and commercial vessels.



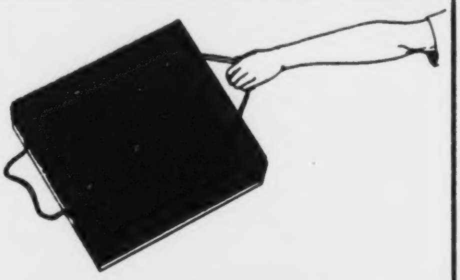
Type II — Near-shore vest

15.5 pounds flotation. Will turn most unconscious persons face up. Acceptable on all recreational boats.



Type III — Flotation aide

15.5 pounds buoyancy. Many special designs for water sports. Acceptable for all recreational boats.



Type IV — Throwable

16.5 pounds flotation. Designed to be thrown, not worn. Acceptable for recreational boats less than 16 feet and canoes and kayaks. Must have as an additional device for boats 16 feet and over.

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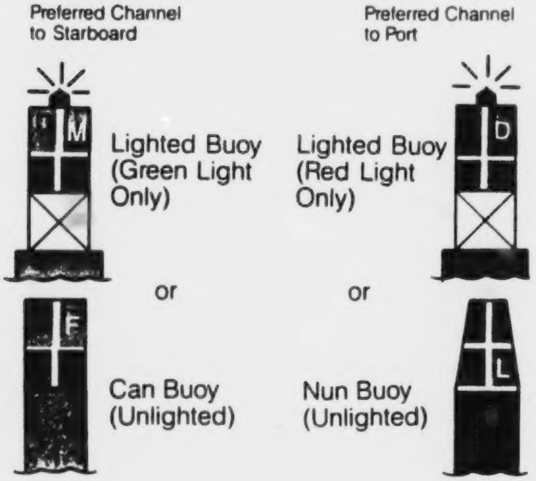
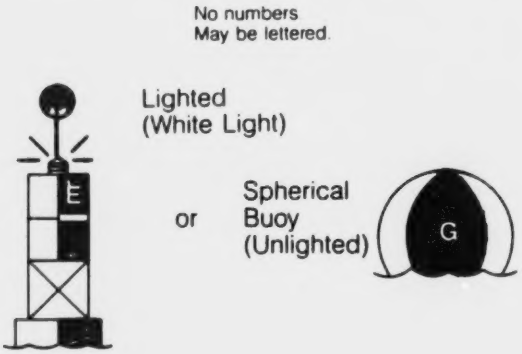
TRANSPARENCY MASTER #3

Uniform State Waterway Marking System

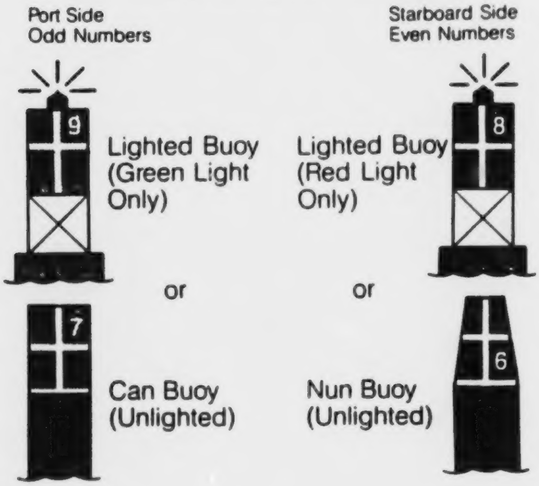
Preferred Channel Aids (Mark bifurcations. No numbers. May be lettered.)


Preferred Channel to Starboard
Preferred Channel to Port
M
Lighted Buoy (Green Light Only)
Lighted Buoy (Red Light Only)
D
or
or
F
Can Buoy (Unlighted)
Nun Buoy (Unlighted)
L

Safe Water Aids marking mid-channels and fairways


No numbers
May be lettered.
Lighted (White Light)
E
or
Spherical Buoy (Unlighted)
G

Lateral Aids Marking the sides of channels as seen when entering from seaward


Port Side Odd Numbers
Starboard Side Even Numbers
9
Lighted Buoy (Green Light Only)
Lighted Buoy (Red Light Only)
8
or
or
7
Can Buoy (Unlighted)
Nun Buoy (Unlighted)
6

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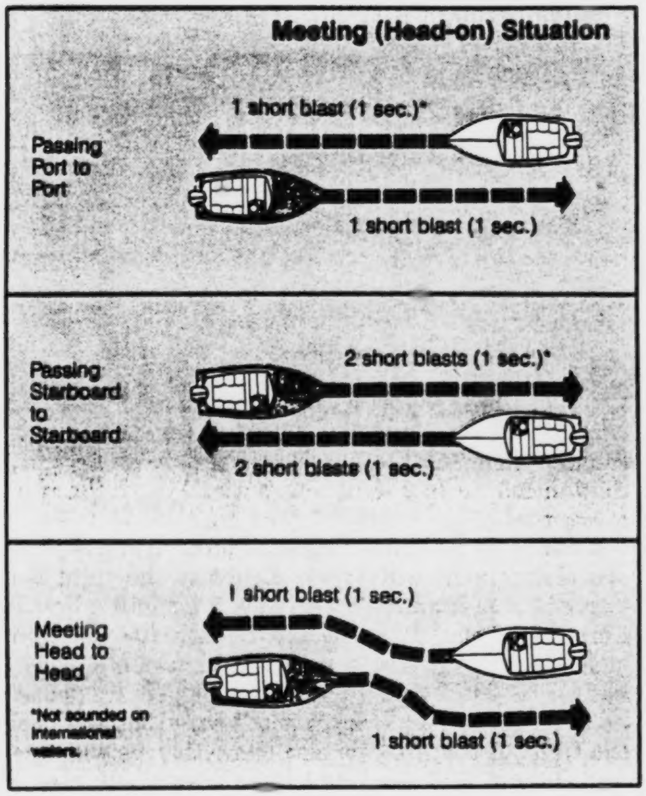
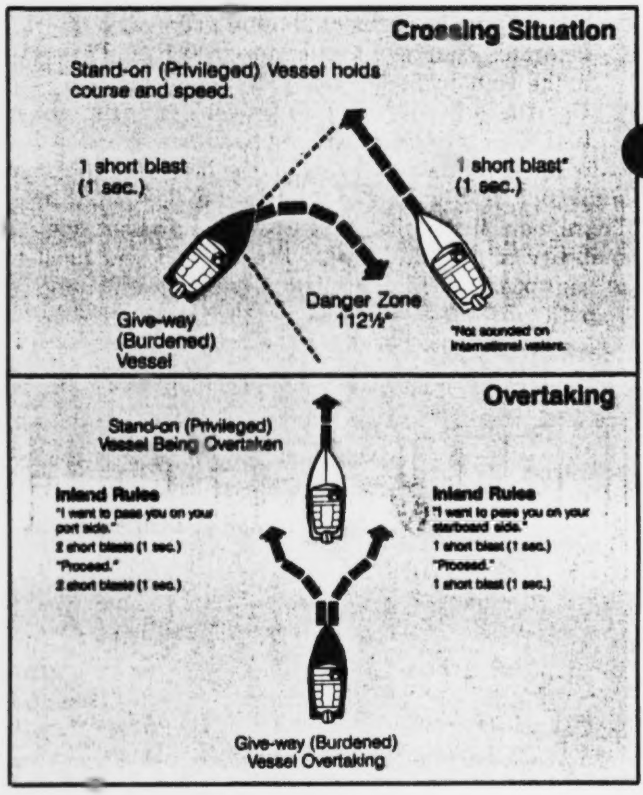
TRANSPARENCY MASTER #4

Boating Safety


Meeting (Head-on) Situation
Passing Port to Port
1 short blast (1 sec.)*
1 short blast (1 sec.)
Passing Starboard to Starboard
2 short blasts (1 sec.)*
2 short blasts (1 sec.)
Meeting Head to Head
1 short blast (1 sec.)
1 short blast (1 sec.)
*Not sounded on international waters.


Crossing Situation
Stand-on (Privileged) Vessel holds course and speed.
1 short blast (1 sec.)
1 short blast* (1 sec.)
Give-way (Burdened) Vessel
Danger Zone 112½°
*Not sounded on international waters.
Overtaking
Stand-on (Privileged) Vessel Being Overtaken
Inland Rules
"I want to pass you on your port side."
2 short blasts (1 sec.)
"Proceed."
2 short blasts (1 sec.)
Inland Rules
"I want to pass you on your starboard side."
1 short blast (1 sec.)
"Proceed."
1 short blast (1 sec.)
Give-way (Burdened) Vessel Overtaking

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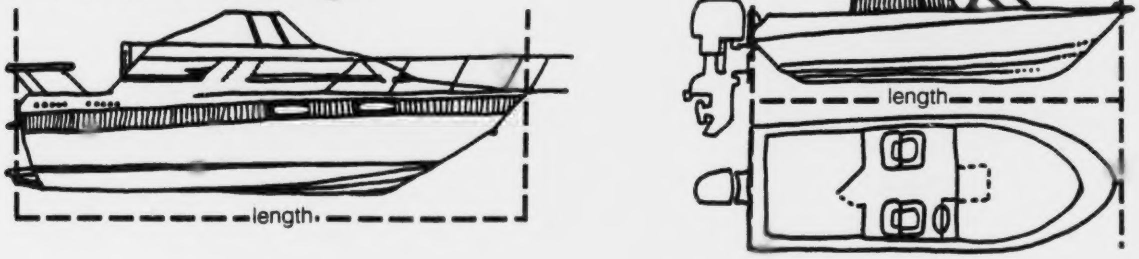
TRANSPARENCY MASTER #5

Determining Maximum Horsepower and Person Capacity for Boats

How to Measure Length



Formulas for Safe Loading

Horsepower Capacity

(small, flat-bottom boats)
Multiply boat length (feet) times transom width (feet)

If Answer is:	Maximum HP is:
35 or less	3
36 - 39	5
40 - 42	7.5
43 - 45	10
46 - 52	15

Note: For flat-bottom, hard chine boats, with an answer of 52 or less, reduce one capacity increment (e.g. 5 to 3).

Persons Capacity

(average weight per person: 150 lbs)

(Boat Length x Boat Width) ÷ 15
= Number of People

Boat length and width are measured in feet. Round fractions DOWN to next lower person.

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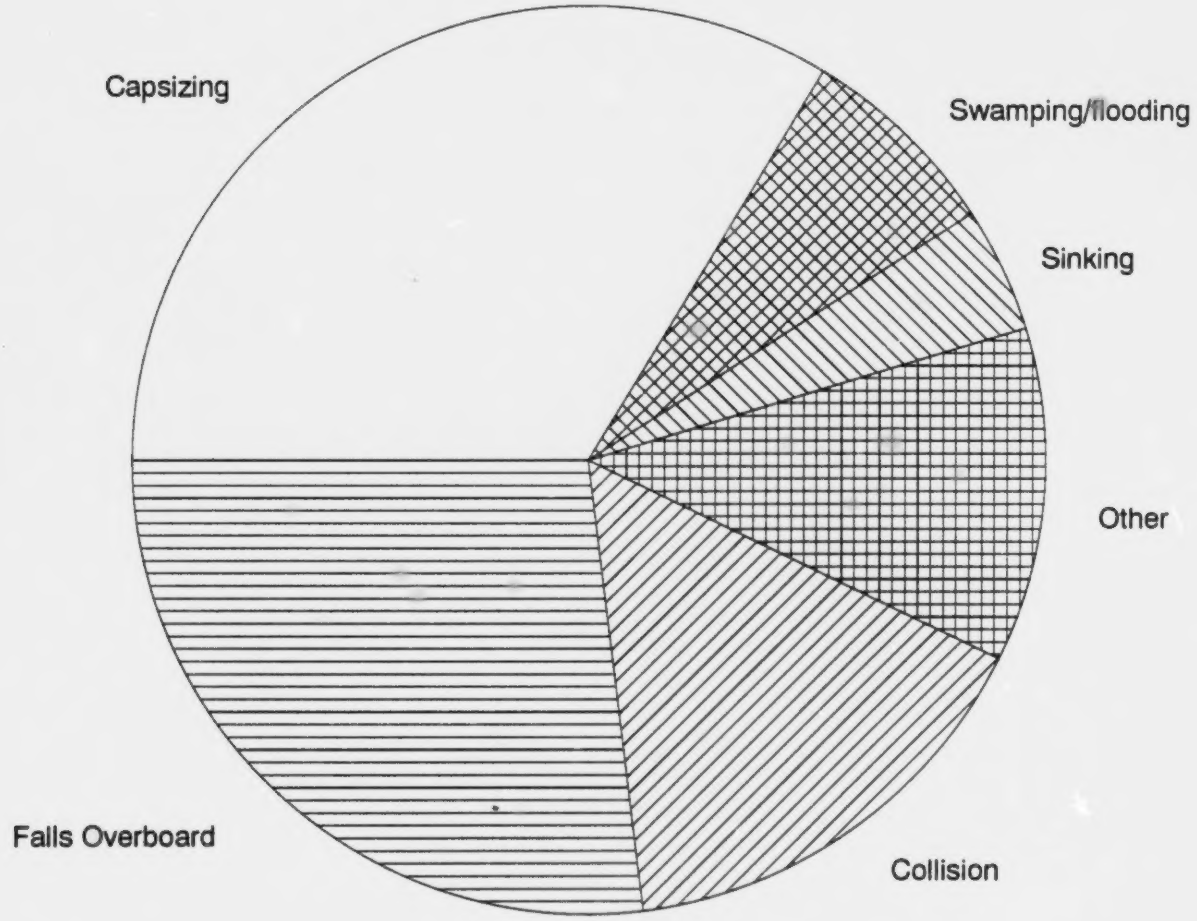
TRANSPARENCY MASTER #6

Boating Fatalities Type of Accident



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TRANSPARENCY MASTER #7

Tips for Safe Boating

- Take a boating safety class offered by your local Power Squadron, Coast Guard Auxiliary, or Red Cross.

- Know your boat's land limit, and don't exceed it. A safe boat is a well-equipped boat. Always carry the necessary safety gear . . . and know how to use it.

- Knowing how to swim just makes good sense if you spend time on the water. If you don't know how, LEARN. However, even good swimmers do not always survive the shock or panic of sudden immersion in cold water.

- Keep life jackets visible and accessible . . . and never make someone feel uncomfortable if they choose to wear a life jacket.

- Learn "the rules of the road" . . . and obey them!

- Don't overdo your boating fun. In three hours of normal boating the noise, motion, sun, wind, and glare can frequently double an individual's reaction time.

- Remember, any alcohol will slow your reaction time, reduce your coordination, and increase your susceptibility to hypothermia.

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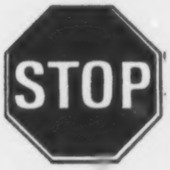
883

TRANSPARENCY MASTER #8

Snowmobile Trail Signs

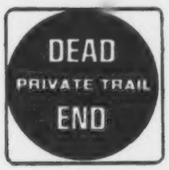
You will encounter these signs as you snowmobile. You should know what they mean.

REGULATORY



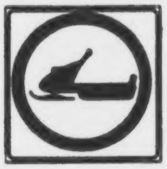
STOP SIGN

PURPOSE: to be used along trails prior to a road crossing
SIZE: 12" x 12" - 9" x 9"
BACKGROUND COLOR: Red
BORDER AND LEGEND: Silver



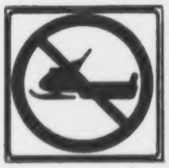
DEAD END PRIVATE TRAIL

PURPOSE: to indicate a limited use trail or designate a restricted area
SIZE: 12" x 12" - 9" x 9"
BACKGROUND COLOR: Silver with red ball
BORDER & LEGEND: Silver



PERMISSIVE

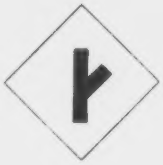
PURPOSE: to indicate snowmobile trails and other areas where snowmobiling is permitted
SIZE: 12" x 12" - 9" x 9"
BACKGROUND COLOR: Silver
LEGEND: Green circle, black snowmobile symbol (may very)



RESTRICTIVE

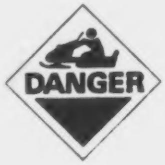
PURPOSE: to indicate areas where snowmobiling is not permitted
SIZE: 12" x 12" - 9" x 9"
BACKGROUND COLOR: Silver
LEGEND: Red circle, black snowmobile symbol

WARNING



TRAIL INTERSECTION

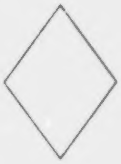
PURPOSE: to indicate an intersection in the trail
SIZE: 12" x 12" - 9" x 9"
BACKGROUND COLOR: Either yellow or orange.
LEGEND: Black 2" x 11" vertical and 2" x 5½" diagonal



DANGER

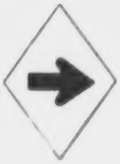
PURPOSE: to indicate an area of danger on the snowmobile trail
SIZE: 12" x 12" - 9" x 9"
BACKGROUND COLOR: Yellow
LEGEND: Black

INFORMATION



TRAIL BLAZER

PURPOSE: shows snowmobiler is still on the trail
SIZE: 5" x 7" - 6" x 6"
BACKGROUND COLOR: Orange with black border

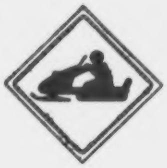


DIRECTIONAL BLAZER

PURPOSE: to indicate changes in trail direction
SIZE: 9¼" x 12" - 9" x 9"
BACKGROUND COLOR: Orange with black border
LEGEND: Black 5¼" directional arrow

TRAIL DESIGNATION or SNOWMOBILE CROSSING SIGN

PURPOSE: to indicate those roadways which have been designated as open for snowmobile use.
SIZE: 30" x 30" - 24" x 24" - 36" x 36"
BACKGROUND COLOR: Yellow
LEGEND: Yellow with black snowmobile symbol



Illinois Department of Conservation

STUDENT ACTIVITIES

STUDENT WORKSHEET #1 — Law Questionnaire

STUDENT WORKSHEET #2 — Boating Trivia Questions

STUDENT WORKSHEET #3 — A Buyer's Guide

STUDENT WORKSHEET #4 — Snowmobile Pre-season Checklist

STUDENT WORKSHEET #5 — Snowmobiler Activity: Experience Survey

STUDENT WORKSHEET #6 — Snowmobiler Activity: Law Questionnaire

STUDENT WORKSHEET #7 — Snowmobiler Activity: Survival Quiz

STUDENT WORKSHEET #8 — Snowmobiler Activity: Sign Matching Quiz

For additional activities, teachers may refer to the "Suggested Teaching Activities and Procedures" section in the Instructor's Guide.

STUDENT WORKSHEET #1

Law Questionnaire

The following chart asks questions about boating laws in Illinois. To help you complete the chart, your instructor will distribute copies of Information Sheet #2 to each student in the class. All answers to the questions on the chart can be found in this information sheet.

> The Illinois law questionnaire is designed to help you review and understand specific state boating laws. Make sure you know these regulations and operating laws before you go boating.
>
> Illinois Department of Conservation

In the State of Illinois:	Details of Illinois Law
1. At what minimum age may you operate a motorboat *alone*?	
2. At what age may a person who has not taken a boating safety course operate a motorboat *alone*?	
3. When accompanied by a parent or guardian?	
4. At what speed should a motorboat travel in waters marked as "No Wake" areas?	
5. When pulling a person on water skis, how many people must be in the boat?	
6. At what time of day is it legal to water-ski?	
7. How many personal flotation devices (PFDs) must be on board while operating any recreational vehicle?	
8. On what size motorboat is a sound signaling device required?	
9. On what size motorboat is a fire extinguisher required equipment?	
10. When a motorboat approaches a boat under sail or being rowed, what must the skipper do?	
11. When must a boat under sail or oars yield the right of way?	
12. What should be done in the case of an accident involving more than $200 worth of damages?	
13. What should be done in the case of an accident which results in death or serious injury?	
14. What boats must be registered?	
15. Where should the application for a watercraft certificate of number be sent?	
16. When must a certificate of number be available for inspection?	
17. How should expiration decals be displayed?	
18. How long may an out-of-state boat owner operate on Illinois waters without applying for Illinois registration?	

STUDENT WORKSHEET #2

Boating Trivia Questions

When a ship is afire and sinking rapidly, what should the Captain say to the crew? Does anybody smoke? Where's the fire station? Abandon ship! I need one volunteer . . . (10)

To propel a boat by working a bar from side to side is called __________. Sculling; scooting; yawing. (20)

A fathom is how deep? 3 feet; 6 feet; 9 feet. (25)

Floating wreckage is called __________. Flotsam; salvage; garbage; junk. (21)

Sailors refer to the oceans and waters of the world as the __________. (5)

The color representing the port side of a boat is _________. (11)

A storm with winds from 32 to 63 miles per hour is called a _________. Gale; blow; draft. (14)

A boat not made fast to a dock or pier and not underway is said to be_________. Lonely; adrift; orphaned; afloat. (3)

A twin-hulled boat is known as a ___________. (24)

The vertical distance from the waterline to the gunwale is called _______________. (16)

Name the first European to discover what is now known as San Francisco Bay. Sir Francis Drake; Christopher Columbus; Guiseppe Veranzano; Lewis and Clark. (7)

The act of moving a vessel by means of a line or laid-out anchor is called ___________. Warp; slide; pull; scull. (19)

Name the term to veer suddenly off course. (23)

Name the expression of surprise uttered when a ship strikes an object with such force that her ribs tremble. (30)

When the wind changes in a counterclockwise direction it is said to _________. Veer; about; back; sheer. (26)

To toss an item overboard is to _______________ it. Deep six; chum; chuck; torpedo. (36)

Name the stretch of water between England and France known to square-rigged sailors as the "Sea of Sore Heads and Sore Throats." (27)

Name the light, used to aid navigation, that is smaller than a light station. (35)

True or false: A "bumboat" is used in ports to sell merchandise. (1)

The Great Barrier Reef is located off the coast of _______________. California; Florida; Australia; Hawaii. (13)

True or false: The passage around the north of Canada from the Atlantic to the Pacific is called the Northwest Passage. (6)

Name the five oceans of the world. (15)

A circular window in the side of a vessel is a _______________. (18)

A sailor said to have "swallowed the anchor" is _______________. Ill with a stomach ache; retired; hiding something; in charge of the anchor. (22)

887

What was the famous message sent by Admiral Nelson to the British Fleet just prior to the Battle of Trafalgar in 1805? We have not yet begun to fight; England expects that every man will do his duty; Damn the torpedos—full speed ahead; Good luck, laddies. (17)

A "Class B Fire" includes all but which of the following? Gasoline; kerosene; wood. (34)

A ladder made of rope or chain with wood rungs is called a ______________. Jacob's Ladder; Daisy Chain; Larry's Ladder; Tar's Ladder. (28)

Name the device used for locating underwater objects by measuring the time taken for an electric impulse to return. (12)

Another name for a captain or master, used mostly on smaller vessels, is ______________. (2)

When a large wave fills a vessel with water, but doesn't sink it, it is said to ______________. (4)

Abaft means: The lowest point in the hull; toward the rear of the boat; aft of amidships. (33)

Give the term used to describe non-boaters by boaters. (29)

The Eskimo word for light is also the name of a canoe-type craft used for fishing. What is it? (8)

SONAR stands for ______________. (32)

Any device used to reduce rolling of a vessel from side to side is called a ______________. (9)

Name the longest artificial lake in the world. (31)

Illinois Department of Conservation
Division of Law Enforcement

STUDENT WORKSHEET #2 — Key

Boating Trivia Questions

1. True
2. Skipper
3. Adrift
4. Swamp it
5. Seven Seas
6. True
7. Sir Francis Drake
8. Kayak
9. Stabilizer
10. Abandon ship
11. Red
12. SONAR
13. Australia
14. Gale
15. Atlantic, Pacific, Indian, Arctic, Antarctic
16. Free board
17. England expects that every man will do his duty
18. Porthole
19. Warp
20. Sculling
21. Flotsam
22. Retired
23. Yaw
24. Catamaran
25. 6 feet
26. Back
27. English Channel
28. Jacob's Ladder
29. Landlubber
30. Shiver my timbers
31. Franklin D. Roosevelt Lake
32. Sound navigating and raising
33. Toward the rear of the boat
34. Wood
35. Beacon
36. Deep six

STUDENT WORKSHEET #3

A Buyer's Guide

With some 2,500 manufacturers making some 4,000 different models of boats, you should be able to find a boat that meets your particular needs. Below is a list of items to consider before you start your search. It will help you to organize your thoughts and will make it easier to find the right boat.

Capacity
(Note: Overloading a boat reduces its stability and can lead to capsizings, swampings, and falls overboard. Check the capacity plate to make sure the boat can handle the number of people and equipment you plan to carry.)

____

Use
(Note: Many boats can be used for a variety of activities, but many newer boating designs emphasize particular capabilities.)

- ☐ Fishing
- ☐ Cruising (day, overnight, extended)
- ☐ Water-skiing
- ☐ Sailing (day sailing, competition, extended cruise)
- ☐ Paddling (calm water, white water, competition)
- ☐ Hunting
- ☐ Diving

Construction Material

- ☐ Wood
- ☐ Fiberglass
- ☐ Aluminum

Power
(Note: On larger boats used on open water, having two motors will provide a safety backup and can be more efficient when trolling.)

- ☐ Outboard
- ☐ Stern Drive
- ☐ Inboard
- ☐ Gas
- ☐ Diesel

Where Used
(Note: Generally the larger the body of water, the larger the boat should be. Remember, however, that most fatalities occur on small bodies of water in small boats. In a small boat, the skill of the operator is an important factor in providing stability.)

- ☐ Open Ocean, Gulf
- ☐ Great Lakes
- ☐ Large Lakes, Bays
- ☐ Rivers
- ☐ Small Bays, Lakes, Ponds
- ☐ Shallow Water

Trailering, Moorage, Storage
(Note: Most boats are trailerable and can be used in many different waters. If not trailerable, is there available moorage?)

- ☐ Trailerable
- ☐ Moorage Availability
- ☐ Storage Availability

Equipment
(Note: To properly and safely enjoy your boat, it should be properly equipped.)

- ☐ Personal Flotation Devices (A wearable device is recommended for everyone even on boats that don't require them)
- ☐ Fire Extinguisher(s)
- ☐ Visual Distress Signals
- ☐ Anchor and Anchor Line
- ☐ Bailer, Pump
- ☐ Oar, Paddle
- ☐ First Aid Kit
- ☐ Horn, Bell
- ☐ Lights
- ☐ Navigation Equipment, Charts
- ☐ Mooring Lines
- ☐ Fenders

Now it's time to check with local boat dealers to see if they can meet your requirements. For perspective, the National Marine Manufacturers' Association figures indicate the average boat sold is about 15 ½ feet long, powered by a 35-horsepower motor. Happy shopping!

Illinois Department of Conservation
Division of Law Enforcement

STUDENT WORKSHEET #4

Snowmobile Pre-season Checklist

Read the operator's manual written specifically for your model snowmobile. Be sure you make all proper adjustments and lubrications, and follow safety suggestions. If any repairs or adjustments are needed, get them done before you travel anywhere on your snowmobile.

☐ **Ignition**
Replacement of spark plugs

☐ **Carburetor/Fuel**
Replacement of fuel filter
Check fittings

☐ **Drive belt**
Check for wear and cracks
Measure old belt and compare to specifications

☐ **Track**
Examine for broken cleats, loose or torn drive holes, and ply separation

☐ **Skis**
Alignment
Examine for loose weld joints, loose or worn out wear rods

☐ **Chain**
Lubrication
Examine chain tension

☐ **Shocks**

☐ **Lights**
Replace burned out bulbs
Apply brakes and check stoplights

☐ **Clutch**
Lubrication

☐ **Brakes**
Proper setting
Free operation
Worn brakes

☐ **Check for loose nuts and bolts on the sled**

☐ **Bogie wheels and/or slides**
Wheel condition
Lubrication
Axle wheels and bearings
Loose nuts and bolts
Broken welds and springs
Slide rails

☐ **Check spare parts and tools**
Light bulbs: pack so they won't break; always replace with correct type; incorrect type could damage electrical system
Spark plugs need to be gapped; check owner's manual for proper setting; in an emergency, a match cover will approximate gap
Spare belt
Tools (pliers, adjustable wrench, screwdrivers: flat and Phillips)
Starter pull rope
Owner's manual
Emergency survival kit

Illinois Department of Conservation
Division of Law Enforcement

STUDENT WORKSHEET #5

Snowmobiler Activity: Experience Survey

The following questions are meant to find out how much experience related to snowmobiling you have had before taking this class. The answers will help your instructor decide how much time to spend on each part of the course. Circle the letter which best describes your experience.

1. I have
   - (a) driven
   - (b) ridden
   - (c) never been on a snowmobile.
2. I have driven a snowmobile
   - (a) more than 10 times
   - (b) 5 - 9 times
   - (c) 1 - 4 times
   - (d) never
3. I have ridden a snowmobile
   - (a) more than 10 times
   - (b) 5 - 9 times
   - (c) 1 - 4 times
   - (d) never
4. I have been camping
   - (a) more than 10 times
   - (b) 5 - 9 times
   - (c) 1 - 4 times
   - (d) never
5. I have been camping in the snow
   - (a) more than 10 times
   - (b) 5 - 9 times
   - (c) 1 - 4 times
   - (d) never
6. I have participated in some winter sport outdoors
   - (a) more than 10 times
   - (b) 5 - 9 times
   - (c) 1 - 4 times
   - (d) never
7. I have received
   - (a) certification from a Red Cross first aid course
   - (b) partial first aid training as part of another type of training
   - (c) no first aid training
8. I have repaired machines or vehicles
   - (a) more than 10 times
   - (b) 5 - 9 times
   - (c) 1 - 4 times
   - (d) never
9. I intend to use a snowmobile mostly for
   - (a) travel
   - (b) recreation
   - (c) both
10. I intend to use a snowmobile
    - (a) on my own land
    - (b) on public recreation areas
    - (c) on other private land
    - (d) in other states/provinces

Illinois Department of Conservation
Division of Law Enforcement

STUDENT WORKSHEET #6

Snowmobiler Activity: Law Questionnaire

The chart which follows asks questions about the laws in your state/province. Your instructor will help you find the laws to fill in the chart. Make sure you know these laws before you go out on a snowmobile. If you travel to other states/provinces to enjoy a different terrain, learn their laws before you go. Many will accept a safety certificate issued by another state/province.

Check (✓) the yes or no column for each question. If you check yes, be sure you explain the law under "Details."

In Your State/Province	Yes	No	Details
1. Is there an agency in the government in charge of snowmobiling?			
2. Is registration required?			
3. May you operate a snowmobile on or near roads and highways?			
4. May you cross roads?			
5. Is there a minimum age you must be in order to drive a snowmobile alone?			
6. Do people of certain ages have to have a license to drive a snowmobile?			
7. Do you have to take a safety course before you can drive alone?			
8. Is there a law about firearms on snowmobiles?			
9. Is there a law about chasing animals?			
10. Is there a law about lights?			
11. brakes?			
12. reflectors?			
13. decibels of sound?			
14. speed?			
15. alcohol or drugs?			
16. mufflers?			
17. helmets?			
18. safety flags?			
19. riding at night?			
20. private or posted land?			
21. litter?			
22. accident reporting?			
23. What is the fine or penalty for violating these laws?			

Illinois Department of Conservation, Div. of Law Enforcement

893

STUDENT WORKSHEET #7

Snowmobiler Activity: Survival Quiz

Circle the letter which best completes the sentence.

1. The most important feature of the first layer of clothing is that it
   - (a) ventilates
   - (b) stays tight around wrists and ankles
   - (c) is thick

2. If a person is injured and not breathing you should
   - (a) go for help
   - (b) wait and see what happens
   - (c) give artificial respiration

3. Shivering and stumbling are symptoms of
   - (a) heart attack
   - (b) frostbite
   - (c) hypothermia

4. If you are in a blizzard, it is best to
   - (a) walk in a straight line
   - (b) stay where you are and keep warm
   - (c) keep moving to keep warm

5. For keeping your hands warm, the best thing is
   - (a) mittens
   - (b) ski gloves
   - (c) long wool cuffs

6. On a trip the most essential thing to take with you is
   - (a) tent
   - (b) a friend on another snowmobile
   - (c) compass and map

7. If the temperature is 10 degrees F, and the wind is blowing 20 mph, you should
   - (a) not go out
   - (b) not worry about frostbite
   - (c) check frequently for frostbite

8. For bright days, wear
   - (a) dark lenses
   - (b) yellow lenses
   - (c) clear lenses

9. If someone cannot move the toes after an injury you should
   - (a) exercise the toes and legs for the victim to keep the body warm
   - (b) consider spinal injury
   - (c) consider spinal injury and not move the victim

10. If a person has a heart attack, you should
    - (a) force the patient to lie down
    - (b) try to impress the patient with the serious condition
    - (c) suggest the patient lie down and say everything will be all right

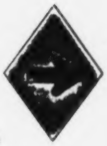
Illinois Department of Conservation
Division of Law Enforcement

804

STUDENT WORKSHEET #8

Snowmobiler Activity: Sign Matching Quiz

Match the sign with its meaning. Place the letter from the correct sign in front of the statement which best describes the meaning of the sign.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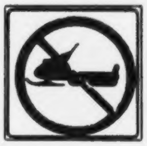
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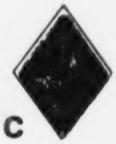
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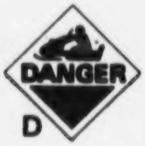

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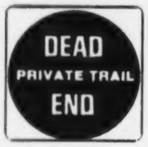

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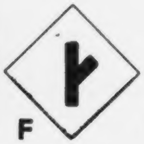
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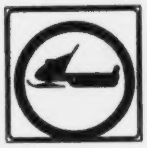
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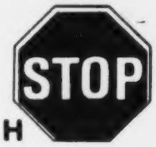


H

___ Points to a change in the direction of the trail

___ Shows trail is limited in use or shows a restricted area

___ Shows that snowmobiling is not allowed in that area

___ Shows that the trail or area is open to snowmobiling

___ Shows that the trail is about to cross a road

___ Shows that the trail intersects another trail

___ Warns of an area needing caution

___ Shows snowmobiler is still on the trail

Snowmobiler Activity: Decision-making Quiz

Think about the following situations. You may wish to discuss them with classmates and your instructor. Decide you would do in each situation.

1. Four inches of snow have fallen and the ground is covered. It is the first snow of the winter. The field down the street looks very inviting for the first drive of the year. Should you go out on your snowmobile? Why or why not?

2. You are all alone and you see a trail you would like to go up. You do not know who owns the land. What should you do?

3. You meet up with some cross country skiers on a trail. What should you do?

Illinois Department of Conservation
Division of Law Enforcement

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Outdoor Recreation

PROBLEM AREA: Managing Golf Courses

RELATED PROBLEM AREAS:

1. Identifying Outdoor Recreational Enterprises
2. Managing Parks and Recreational Areas
3. Conserving Water Resources
4. Managing Land Resources

PREREQUISITE PROBLEM AREA(S):

1. Agribusiness Operation and Management Unit (Agricultural Business and Management)

LEVEL: Preparatory

OCCUPATIONAL TASKS ADDRESSED:

Agricultural Resources Cluster

Duty A: Managing the Recreational Facility

1. Contribute to annual park management update
2. Identify specific recreational program needs for visitors
3. Communicate orally with visitors
4. Determine land-use capability
5. Assist in development of resource conservation plans

Duty B: Applying Laws, Regulations, and Policies

1. Maintain permits, certificates, and licenses
2. Maintain crowd control
3. Prepare service work order
4. Direct vehicular and pedestrian traffic

Duty C: Performing Promotional Activities

1. Give information and directions in a variety of formal and informal settings
2. Lead or guide recreational activities
3. Stimulate interest and participation in recreational activities for special groups

Duty D: Managing Facility Flora and Fauna

1. Identify plant communities and dominant species within a selected area

Duty G: Assembling, Servicing, and Maintaining Equipment and Facilities

1. Follow a facility and grounds maintenance schedule
2. Report facility and grounds maintenance needs
3. Maintain grounds and recreational areas
4. Perform preventative and scheduled maintenance activities on grounds and facilities

Duty H: Applying Safety Practices

1. Monitor equipment for safe operation

STATE GOALS FOR LEARNING

In planning the instruction for this problem area, teachers can promote the development of several student learning objectives which are related to the State Goals for Learning in Biological and Physical Sciences, Mathematics, and Social Sciences. These objectives are listed on the Learning Assessment Plan forms included on the following page(s). Those learning objectives marked with an asterisk (*) are taken from the sample lists provided by the Illinois State Board of Education.

CORE

Illinois Agricultural Core Curriculum

Agricultural Education 124 Mumford Hall 1301 W. Gregory Drive University of Illinois Urbana, IL 61801

Director: Dale A. Law, Ed.D.
Principal Investigator: Jerry D. Pepple, Ed.D
Research Assistant: Kevin J. Enderlin

Illinois Agricultural Core Curriculum Rev.

Submission Date ____________

☐ Original submission ☐ Revision

Page ____ of ____

I. LEARNING AREA *(check one)*

☐ Language Arts	☐ Fine Arts
☐ Mathematics	☒ Social Sciences
☐ Sciences	☐ Physical Development/Health

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

(Affix label or complete district information.)

COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐

District Name

City

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will be able to apply the skills and knowledge gained in the social sciences to decision making in life situations.

Contact Person: ____________

Title: ____________

Phone: (   )

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Understand the knowledge and skills required for success in selected fields of work.					
*2. Recognize that competence in a field of work entails the development of a wide range of skills.					
3. Describe the economic and physiographic criteria that affect golf course site selection.					
4. Identify the intensity of golf play on an annual basis.					
898					899

Managing Golf Courses

Agricultural Resources
Outdoor Recreation

Illinois Agricultural Core Curriculum Rev.

Managing Golf Courses

Submission Date ____________ ☐ **Original submission** ☐ **Revision**	Page ____ of ____

I. LEARNING AREA *(check one)*

☐ Language Arts
☒ Mathematics
☐ Sciences
☐ Fine Arts
☐ Social Sciences
☐ Physical Development/Health

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

(Affix label or complete district information.)

COUNTY	DISTRICT	ESC

District Name

City

Contact Person: ____________

Title: ____________

Phone: ( )

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will be able to make and use measurements, including area and volume.

III. LEARNING OBJECTIVES

By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:

III. LEARNING OBJECTIVES	IV. ASSESSMENT A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	V. EXPECTATIONS Percent of Students Expected to Achieve Objective
*1. Measure in a variety of contexts using appropriate units.					
*2. Find areas and volumes of figures resulting from combining common geometric figures.					
3. Accurately measure yardage and area on regular and irregularly shaped fairways and greens.					

Agricultural Resources
Outdoor Recreation

Illinois Agricultural Core Curriculum Rev.

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

Submission Date ____________________
☐ **Original submission** ☐ **Revision**

Page _____ of _____

I. LEARNING AREA *(check one)*
☐ Language Arts ☐ Fine Arts
☒ Mathematics ☐ Social Sciences
☐ Sciences ☐ Physical Development/Health

(Affix label or complete district information.)

COUNTY	DISTRICT	ESC

District Name

City

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will be able to identify, analyze, and solve problems using algebraic equations, inequalities, functions, and their graphs.

Contact Person: ____________________
Title: ____________________
Phone: (   )

III. LEARNING OBJECTIVES

By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:

III. LEARNING OBJECTIVES	IV. ASSESSMENT A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	V. EXPECTATIONS Percent of Students Expected to Achieve Objective
*1. Solve linear equations.					
*2. Solve equations and inequalities found in everyday life.					
3. Accurately measure yardage and area of regular and irregularly shaped fairways and greens.					

Managing Golf Courses

Agricultural Resources
Outdoor Recreation

ISBE 41-78 (1/88)

Submission Date ____________
☐ Original submission ☐ Revision
Page ____ of ____

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

(Affix label or complete district information.)

COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐

District Name

City

I. LEARNING AREA *(check one)*

☐ Language Arts
☐ Mathematics
☒ Sciences
☐ Fine Arts
☐ Social Sciences
☐ Physical Development/Health

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will have a working knowledge of the social and environmental implications and limitations of technological development.

Contact Person: ____________
Title: ____________
Phone: (   )

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Recognize the variety of Illinois' natural areas and relate them to economics and recreation.					
2. Describe the economic and physiographic criteria that affect golf course site selection.					
3. Identify the three types of golf course designs and the difficulty of play on each type.					

ISBE 41-78 (1/88)

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Outdoor Recreation

PROBLEM AREA: Managing Golf Courses

STUDENT LEARNING OBJECTIVES

Upon completion of their study of this problem area, students will be able to:

1. Accurately measure yardage and area on regular and irregularly shaped fairways and greens.
2. Identify and describe the differences between daily fee, municipal, and private golf clubs.
3. Identify the intensity of golf play on an annual basis.
4. Describe the economic and physiographic criteria that affect golf course site selection.
5. Identify the three types of golf course designs and the difficulty of play on each type.
6. Discuss the components of putting green quality.
7. Identify the major parts of a putting green.
8. Discuss proper mowing, fertilization, and irrigation practices used on putting greens.
9. Discuss proper mowing, fertilization, and irrigation systems used on golf courses.
10. Identify the careers available in golf course management and the training needed to gain employment in those careers.

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Outdoor Recreation

PROBLEM AREA: Managing Golf Courses

PROBLEMS AND QUESTIONS FOR STUDY	INSTRUCTOR'S NOTES AND REFERENCES
1. Why do we need to determine the surface area of the fairway and green?	
2. How do daily fee, municipal, and private golf clubs differ?	
3. Do management practices for golf courses differ depending on amount of usage?	
4. What should be considered when selecting a site for construction of a golf course?	
5. Do golf courses differ in level of difficulty?	
6. What are the major parts of a putting green?	
7. How do we maintain putting green quality?	
8. How do fertilization needs differ between putting greens and fairways?	
9. How do mowing practices differ between greens and fairways?	
10. How do irrigation practices differ between greens and fairways?	
11. How do the major types of irrigation systems differ in regard to labor requirements?	
12. What types of career opportunities are available in golf course management?	

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Outdoor Recreation

PROBLEM AREA: Managing Golf Courses

SUGGESTED TEACHING ACTIVITIES AND PROCEDURES

1. Have students select an area that would be best suited for construction of a golf course. Students should consider both economic and physiographic criteria in the selection process.
2. Visit a local golf course. Have students identify the management practices used.
3. Have students design a three-par golf course for the school grounds or community park.
4. Have students select a career in golf course management. Direct them to contact a local person working in that career. Have the students then develop a career plan for preparing them for their selected career.

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Outdoor Recreation

PROBLEM AREA: Managing Golf Courses

REFERENCES

*1. *Turf Management for Golf Courses*. Beard, James B. MacMillan Publishing Company, Inc., Front and Brown Streets, Riverside, NJ 08075. (609) 461-6500 or (800) 257-5755.

2. *Turfgrass Science and Management*. Emmons, R.D. (1988). Delmar Publishers, 2 Computer Drive West, Box 15015, Albany, NY 12212-5012. (800) 347-7707.

*Indicates highly recommended reference

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTIONAL RESOURCES

These resources are intended for use by teachers in planning and teaching the materials for this problem area and may be adapted to fit the teaching method(s) used.

INFORMATION SHEET #1 — Golf Terms to be Defined

INFORMATION SHEET #2 — Types of Golf Courses

INFORMATION SHEET #3 — Course Usage

INFORMATION SHEET #4 — Course Measurement and Par Ratings

INFORMATION SHEET #5 — Building a Golf Course

INFORMATION SHEET #6 — Course Design

INFORMATION SHEET #7 — Putting Green

INFORMATION SHEET #8 — Putting Green Management

INFORMATION SHEET #9 — Fairway Management

INFORMATION SHEET #10 — Types of Irrigation Systems

INFORMATION SHEET #11 — Careers in Golf Course Management

TRANSPARENCY MASTER #1 — Growth of Golf Course Facilities in the United States

TRANSPARENCY MASTER #2 — Area Measurement

TRANSPARENCY MASTER #3 — Course Design

TRANSPARENCY MASTER #4 — Putting Green

TRANSPARENCY MASTER #5 — Putting Green Cross-Section

TRANSPARENCY MASTER #6 — Mowing a Green

TRANSPARENCY MASTER #7 — Mowing Practices Utilized on Golf Course Fairways

TRANSPARENCY MASTER #8 — The Fairway

TRANSPARENCY MASTER #9 — Hierarchy of Management

INFORMATION SHEET #1

Golf Terms to be Defined

Casual water — any temporary accumulation of water which is visible before or after the player takes his stance and which is not a hazard.

Course — whole area within which play is permitted. It is the duty of the club officials to define its boundaries accurately.

Flag stick — movable straight indicator provided by the club officials. Stick is centered in the hole to show its position.

Bunker — area of bare ground; often a depression, usually covered with sand.

Water hazard — any sea, lake, pond, river, ditch, surface drainage ditch, or other open water.

Hole — shall be 4.25 inches in diameter and at least four inches deep.

Loose impediment — natural objects not fixed or growing and not adhering to the ball. Dung, worms, and insects are examples of loose impediments. Sand and loose soil are loose impediments on the putting green, but not elsewhere on the course.

Out-of-bounds — ground on which play is prohibited. A ball is out-of-bounds when all of it lies out-of-bounds.

Putting green — all ground of the hole being played which was specially prepared for putting. A ball is deemed to be on the putting green when any part of it touches the putting green.

Teeing ground — starting place for the hole to be played.

Through the green — whole area of the course except teeing ground and putting green of the hole being played and all hazards of the course.

INFORMATION SHEET #2

Types of Golf Courses

The three major types of golf courses are:

1. Daily fee golf course — a course open to the public. It is usually owned by an individual, partnership or corporation and is operated as a business venture. The operating policy is designed to return a reasonable net profit to the owners. Many of these courses are associated with resorts or land developments.
2. Municipal golf course — a course constructed and operated by a tax supported agency such as a state, county, township, city, town or park district. Its chief goal is to provide golfing to its citizens at a reasonable cost.
3. Private golf club — a limited-use facility, usually non-profit, designed to meet the specific needs and desires of a restricted membership.

INFORMATION SHEET #3

Course Usage

The intensity of golf play on an annual basis for an 18-hole golf course can be categorized as follows:

1. Low — Less than 15,000 rounds per year
2. Medium — 15,000 to 35,000 rounds per year
3. High — 35,000 to 50,000 rounds per year
4. Very high — Above 50,000 rounds per year

The intensity of play is significant in that it influences both the annual maintenance budget and the specific types and levels of turf grass cultural practices employed.

INFORMATION SHEET #4

Course Measurement and Par Ratings

Yardage Measurement

The need for accurate yardage measurement on every hole on a golf course is not only obvious but critical. A golfer's most helpful single aid is a score card showing the accurate yardage of each hole. It is the responsibility of a club or association of clubs to arrange for precise measurement of the golf course.

Permanent yardage markers indicate precise measurement. Permanent reference markers are placed at a standard starting point, commonly the middle of each teeing area. Markers are best made of concrete, steel, or a similar material that insures permanency. Each should bear a number indicating the true yardage from the precise point on the tee to the center of the putting green.

Area Measurement

The area of each green, tee, and fairway is essential information needed by the golf course superintendent to determine the amounts of fertilizer, herbicide, fungicide, or insecticide needed for a particular use and to confirm that the material has been applied at the proper rate.

Most golf course turfs have irregular shapes rather than distinct geometric configurations. For this reason, it is not possible to measure each green, tee, and fairway to within a few square feet. One method of measuring and calculating irregularly shaped turf areas, such as fairways, is summarized as follows:

Step 1 — Subdivide the area into the best possible fit of circles, rectangles, triangles, and trapezoids. A set of stakes placed at the junctions will aid in sighting the lines and facilitating accurate measurements.

Step 2 — Measure the linear dimensions of each geometric figure.

Step 3 — Make a drawing of the turf area, including the geometric figures used and linear measurements obtained.

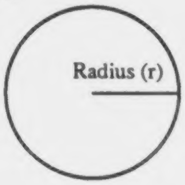
Step 4 — Compute the area of each individual geometric figure.

Step 5 — Calculate the total surface area by adding together the areas of each individual geometric figure.

Step 6 — Check the calculations.

Formulae for calculating areas of primary geometric configurations used in measuring the surface area of golf course turfs are given below.

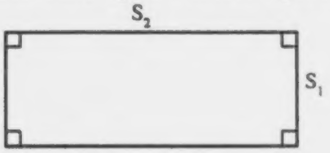
Circle: A figure in which all lines drawn from the center to the periphery are equal



$\pi = 3.14$
$r = 43$ ft.

Area $= \pi r^2$
$= 3.14 \times 43 \times 43 = 5{,}805.9$ sq. ft.

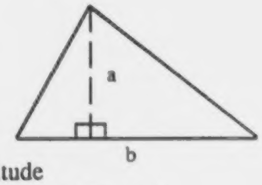
Rectangle: A four-sided figure with four right angles



$S_1 = 40$ ft.
$S_2 = 75$ ft.

Area = product of the adjacent sides
$= S_1 \times S_2 = 40 \times 75 = 3{,}000$ sq. ft.

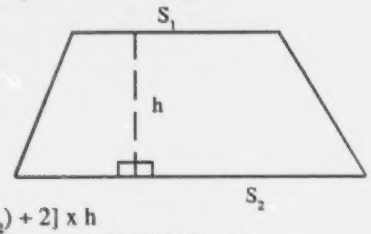
Triangle: A three-sided figure



$a = 22$ ft.
$b = 35$ ft.

Area = 1/2 base x altitude
$= 1/2\, b \times a = 35 \times 22 = 385$ sq. ft.

Trapezoid: A four-sided figure having only two sides parallel, these being of unequal length



$S_1 = 32$ ft.
$S_2 = 75$ ft.
$h = 40$ ft.

Area $= [(S_1 + S_2) \div 2] \times h$
$= [(32 + 75) \div 2] \times 40 = 2{,}140$ sq. ft.

United States Golf Association Yardage Guidelines for Par Ratings

Yardage Maximum and Minimum

Par Rating	Men	Women (Front)
3	To 250 (228.5*)	To 210 (192)
4	251 to 470 (229 to 429.6)	211 to 400 (192.8 to 365.6)
5	471 (430.5) and over	401 to 575 (366.5 to 525.6)
6		576 (526.5) and over

*Meters

INFORMATION SHEET #5

Building a Golf Course

Selecting the Architect

Designing a golf course requires the full attention of a competent golf architect. Selecting the architect is one of the most important acts in the development of a golf course and should not be done in haste.

Site Selection

A number of factors enter into the site selection process. They are:

1. Economic Criteria

   a. *Potential golfing demand* — Potential demand is the foremost criterion in site selection. Often a golf course is built in an outlying area where potential for population growth or resort development is good. However, patrons may be reluctant to travel to the course if a comparable facility is closer. Thus, the location of the course in terms of accessibility and convenience can play a major role in its success.

   b. *Land costs* — Land cost is an important consideration in site selection. Prime industrial or residential sites near urban centers have become almost too expensive for the development of privately owned and operated courses. More distant sites on marginal land may be more economical to purchase.

2. Physiographic Criteria — It is usually difficult to locate a site having an ideal combination of physiographic characteristics. Significant savings can be realized in the construction of the golf course if these factors are carefully analyzed during the site selection.

   a. *Land area required* — The actual area required for the course depends on:

      topography
      property configuration
      course length desired
      number and size of trees
      ponds and lakes or streams
      amount of space planned between adjacent golf holes
      relationship of the golf course to surrounding real estate

      A golf course length of 6,300 to 65,000 yards, and a fairway width of 45 yards can be developed on a minimum of 120 acres. However, it is generally advisable to acquire from 160 to 200 acres for an 18-hole golf course that will include a practice range, clubhouse, parking lot, and maintenance facility.

   b. *Topography* — Golf course character is strongly influenced by the topography of the site. Topography, more than any other factor, dictates the flow, routing, and layout of individual holes. Flat sites afford an almost arbitrary use of the land, while more rugged topography will suggest designs that take advantage of natural features.

   c. *Soil suitability* — It is possible to grow grass in most soil types, provided surface drainage is good and the appropriate use of cultural practices are employed. However, there are limits in terms of practicability and economics. Unfavorable soil conditions translate to increased construction costs and difficulties as well as higher expenditures for future maintenance programs. A relatively coarse soil texture is preferred.

   d. *Site drainage* — As a general rule, constructing a golf course in a low, poorly drained area will be much more expensive than constructing it on an elevated, well drained site. Water-saturated soils and standing water on a golf course following intensive rain can delay play for prolonged periods, sometimes up to several days. In some regions this could mean the loss of 20 to 40 golfing days per year and many unhappy golfers.

      Visual signs of draining problems include the presence of cattails, reeds, and sedges. These conditions indicate that prolonged water saturation has occurred at some time during the year.

      Two types of drainage must be provided:

      Surface runoff — This is the most rapid and easiest method of removing excess water during intense or prolonged rains. Surface runoff can be provided by having crowned fairways and a minimum of one to three percent slope or rolling terrain. These slopes should direct water to diversion ditches and eventually in grass waterways.

Subsurface drainage — This involves the entrance of water into the soil, its percolation or movement through the soil, and its eventual removal through subsurface drainage lines.

e. *Vegetation* — Preservation of existing stands of mature trees and shrubs adds greatly to the appearance and challenge of the course. A planting program can be initiated if trees are lacking, but many years are needed to produce a mature wooded appearance. Potential golf course sites which have been in agricultural production should be evaluated in terms of past herbicide usage. Herbicides with specific toxicity to grasses may have been used for years on some crop production lands. A toxic residue can remain for years in the soil and may create problems in the establishment of turf grass.

f. *Power and water availability* — The availibility of power and water sources must be considered in site selection.

Power — The availability of and distance to fuel and power adequate to operate the golf course facility should be determined. An irrigation pumping system may require a 220/480 volt (three phase) power source. If the power source is a substantial distance away, the cost for connecting lines can become quite large.

Water — The availability and quality of water are critical factors in selection of a golf course site. Water is a key cultural factor in the maintenance of quality greens and tees. Irrigation is also needed to maintain quality fairway turfs on most golf courses in North America. Water source criteria include:

- the minimum amount required per time unit
- total quantity of water available
- water quality
- the cost

The actual amount of water needed within a given period depends on such factors as the turf grass species, evapotranspiration rate, physical properties of the soil, and amount and distribution of precipitation.

Water for irrigating golf courses may be obtained from a well, stream, river, lake, pond, drainage canal, municipality, utility company, or a combination thereof.

INFORMATION SHEET #6

Course Design

A well-designed course is a challenge to all degrees of golfing skill without being burdensome or uninteresting.

The degree to which design principles are applied varies according to the intended use of the golf facility. Public fee or municipal courses may exhibit only the elemental concepts of strategy having few bunkers and other hazards. A course designed specifically for hosting major championships usually has numerous bunkers and water hazards.

Golf course design, or more specifically, the design of individual golf holes, falls into three major categories:

1. Strategic design — This is the most frequent design philosophy used in the United States. The design offers the golfer more than one way to play the hole. The design imposes the responsibility of making the choice on the golfer. The focus of this design is that a good course should require thought as well as technical skill. When a direct route presents a hazard (bunker or water) beyond the players shot-making ability, an alternative route is offered which is less risky, less demanding, and less penalizing.
2. Penal design — Penal architecture, as it flourished during the early part of this century, resulted in courses that were both frustrating and humbling to play. Extensive use of deep, frightening bunkers, high, rough trees, and occasionally water, left the golfer no choice in how to play the course. Basically, there is only one route to play each hole. Following the line of play on each hole is an exacting, demanding assignment. The increased popularity of golf, along with greater emphasis on the pleasurable rather than the punishing aspects of the game, brought about the demise of the narrow philosophy of solely penal design. Absolute penal architecture in a golf course is a thing of the past. Today's concept of penal architecture is much softer, although the basic idea remains the same.
3. Heroic design — In the heroic concept of design, the architect challenges the golfer to limit his or her ability by requiring a truly monumental shot to reach the objective. The opportunities to cut across a water hazard or bunker to shorten the distance to the green are typical of the temptations offered on a heroic hole. The design may dictate that the greater the miss the greater the penalty.

918

INFORMATION SHEET #7

Putting Green

A putting green is all the ground of the golf hole being played which is especially prepared for putting. A ball is considered to be on the green when any part of it touches the green. Good putting green design provides a fair, but challenging, test of skill and contributes to economical maintenance. A putting green should be large enough to provide variability in contours, offer a challenge to the golfer, and provide flexibility in cup placement.

Putting greens in North America range from 1,200 to 27,400 square feet in size, with 5,000 to 7,500 square feet being the most popular range. Generally, the longer the hole the larger the putting green, and the shorter the hole the smaller the putting green, with more tightly positioned bunkers.

Surface drainage from a putting green should be in two or more directions. Contouring a green so that all the surface water drains to the front where traffic enters should be avoided. Gentle to moderate contours are preferred to avoid mower scalping on ridges. The slope on the major portion of the green should normally not exceed three percent, although some portions may exceed this.

Components of Putting Green Quality

Components of turf grass quality on a putting green include:

- Uniformity
- Smoothness
- Firmness
- Resiliency
- Close mowing
- Absence of grain

Ball roll is the distance a golf ball moves after it strikes the green on termination of its air flight or as a result of a putting stroke.

The speed or velocity of a green is determined by the height of cut, mowing frequency, smoothness, firmness, and fertility level. Typically, putting greens are closely mowed at 3/16 to 1/4 inch to achieve the uniformity and smoothness required for trueness of ball roll, speed of the green, and bounce for the approach shot. Close, frequent mowing results in very high shoot density and vertical leaf orientation.

INFORMATION SHEET #8

Putting Green Management

Mowing

Mower type — The use of an eight or nine bladed reel-type mower is necessary to maintain a uniform putting green surface of desired quality. Two basic types of mowers are used:

1. A walking greens mower with a 20- to 22-inch mowing width.
2. A three gang greens mower with a 58- to 62-inch mowing width.

Mowing frequency — Daily mowing is preferred to achieve the best playing conditions, especially during periods of active shoot growth. Less frequent mowing results in a green of somewhat poorer shoot density and coarser leaf texture. This causes unpredictable ball movements and a substantial reduction in the velocity of ball roll.

Cutting height — The preferred effective cutting height on greens is 3/16 to 1/4 inch. The lower cutting height is preferred if proper shoot density can be maintained and the greens are not severely contoured.

Mowing pattern — The operating direction normally is altered at each mowing in each of four directions to minimize the development of grain. This results in a distinctive checkboard or striped pattern. A consecutive ribbon pattern is suggested for each individual mowing. It is attractive and minimizes compaction during turning on the green edges.

Clipping removal — Clippings are caught in baskets attached to the mowing units and are then removed from the putting green. The baskets must not be allowed to fill up, as their increasing weight causes a variance in mower performance, especially in cutting height. Grass clippings should be removed from the green area every day after completion of the mowing operation.

Fertilization

The nutrient requirements of putting greens vary with the amount of water applied, the soil's nutrient-holding capacity, climate, and turf grass species. No one fertilization program or fertilizer covers all situations.

Time of fertilization — A complete fertilizer containing nitrogen, phosphorus, and potassium is usually applied in the spring or late summer and early fall. Periodic supplement nitrogen applications are made throughout the remainder of the growing season. Potassium and iron are also added as needed.

Method of application — A common method of greens fertilization of a dry fertilizer is with a centrifugal spreader. Irrigation is required after fertilizer application to insure that the fertilizer moves through the turf and into the soil. Fertilizer particles that remain on the leaf surface for a period of time have an increased probability of causing foliar burn. Another potential problem is the removal of fertilizer particles during mowing if steps are not taken to insure fertilizer penetration into the soil.

Water-soluble fertilizers can be applied with the use of a large-capacity sprayer or an irrigation-fertilization injection system. This procedure is termed fertigation. A small amount of fertilizer can also be included with pesticide spray applications.

Nitrogen — Sufficient nitrogen must be applied to maintain turf grass shoot density, adequate recuperative potential, moderate shoot growth rate, and good color. Nitrogen is usually applied at one- to three-week intervals during periods of normal shoot growth. Excessive nitrogen fertilization is a greater problem on greens than is a nitrogen deficiency. Too much nitrogen leads to thatch accumulation, increased disease problems, reduced tolerance to environmental stress, and restricted root systems.

Potassium — Potassium is prone to leaching through the soil, especially on sand root zones. Potassium is important in maintaining heat, cold, drought, and wear tolerance, as well as in enhancing root growth. As a general rule, the potassium requirement is approximately 50 to 75 percent that of nitrogen.

Iron — Iron is the micronutrient most commonly deficient on greens, especially where the pH, organic matter content, or phosphorus level is high. Applications of iron sulfate, chelated iron, or ferrous ammonium sulfate will correct iron deficient soils.

Phosphorus — Phosphorus is required in much smaller amounts on putting greens than are nitrogen or potassium. The phosphorus fertilization rate should be based on soil test results. This nutrient is usually applied only one to two times per year, during spring and late summer or early fall. Phosphorus is usually applied as a component of a complete fertilizer. It is sometimes questionable whether any phosphorus is required, particularly since visible growth responses are seldom observed.

High phosphate levels are quite common in older greens. It is important that excessively high phosphorus levels be avoided because of downward leaching. The leaching of phosphorus into groundwater can lead to a water quality problem.

Soil pH

The preferred pH range for optimum turf grass growth and vigor is 6.0 to 7.0 for bermudagrass, 5.5 to 6.5 for bentgrass, and 6.2 to 7.2 for annual bluegrass. The need for pH adjustments is more likely on intensely irrigated, highly leached sand root zones, or where irrigation water has a substantial alkaline effect.

The material most commonly used for raising pH is agricultural limestone, while the material most commonly used for lowering pH is sulfur.

Irrigation

Irrigation is the most important factor in greens maintenance. Each green should be irrigated according to its topography, exposure, soil texture, turf grass species, intensity of traffic, rooting depth, and evapotranspiration rate.

Irrigation frequency — Deep wetting, infrequent irrigation is best when possible. Light, daily irrigation of greens may be necessary, particularly during mid-summer.

Irrigation timing — Most deep wetting irrigation is accomplished during the night. A light irrigation at dawn is desirable to remove dew. This results in better playing conditions during early morning hours.

Water application rate — Water application should be uniform over the green and collar to avoid wet or dry spots. The rate should be adjusted in relation to soil infiltration and percolation rates. The water use rate is normally in the range of one to two inches per week.

INFORMATION SHEET #9

Fairway Management

Mowing

The position of a golf ball on the fairway turf is critical to the golfer in achieving proper control when hitting a shot from the fairway. Ball position is controlled by the stiffness and number of turf grass leaves beneath the ball. Leaf number is determined by cutting height, fertility, and irrigation levels. Leaf stiffness is influenced by the irrigation and potassium levels.

Mower type — Five- to ten-bladed reel mowers are used to maintain proper fairway surface quality. Reel mowers are usually operated in five, seven, or nine gangs which are either pulled or tractor-mounted.

Mowing frequency — The frequency at which fairway turf must be mowed is influenced primarily by the turf grass growth rate. Irrigated turf is generally mowed on a regular basis, with a two- to three-and-a-half-day interval between mowings. Unirrigated turf can vary in mowing frequency depending on weather conditions.

Fairway mowing should be done in early morning, ahead of intensive play, and when the surface is not wet, if at all possible.

Cutting height — The cutting height selected will vary depending on the desires of the golfing clientele, the turf grass species, and the available operating budget. Thus, the cutting height may range from a low of 0.5 inch to a high of 1.2 inches. Generally, the closer cutting height for each grass species is desired. The best shot control is achieved on a very closely mowed turf.

During periods of intense mid-summer heat stress, it may be advisable to raise the cutting height temporarily by 1/8- to 1/4-inch on fairways with cool-season turf species.

Mowing pattern — Alternating the mowing pattern on fairways encourages upright growth of the turf grass shoots for better ball lie. Fairways mowed only longitudinally should be alternated in opposite directions. Preferably a fairway should be cross mowed at least once a month.

Turf Grass Selection

The characteristics desired in fairway turf grass include: high shoot density, adaption to cutting height of 0.5 to 0.8 inch, minimum thatching tendency, rapid recuperative rate, tolerance to compacted soils, tolerance to intense wear, and moderate resistance to major disease and insect pests.

Fertilization

The nutrient requirements for fairways vary with soil type, soil nutrient-holding capacity, amount of water supplied, climate, turf grass species, and amount of play. No one fertilizer program or fertilizer can suit all situations. Soil tests should be used as the basic guide to nutrient requirements and pH levels.

Irrigation

Determining proper irrigation practices on fairways is one of the most difficult day-to-day decisions made by a golf course superintendent. Each fairway or portion of a fairway should be irrigated individually in accordance with topography, exposure, soil texture, turf grass species, intensity of traffic, rooting depth, and evapotranspiration rate. The basic concept in fairway irrigation is moistening of the full depth of the root zone just prior to appearance of foot printing or symptoms of visual wilt.

922

INFORMATION SHEET #10

Types of Irrigation Systems

There are three main types of turf grass irrigation systems in use on golf courses in North America.

Automatic Irrigation System

This system is by far the most popular type being installed on today's golf courses. In this system, fixed pop-up sprinkler heads are automatically activated by control valves. The control valves are operated by an electric signal received from a controller. The controller can regulate irrigation for specific days, time of day, and operating duration for any number of sprinklers.

Advantages:

1. It places the essential control of golf course turf irrigation directly with the most competent individual or staff.
2. There is precise timing of each sprinkler head in operation.
3. There is no need to hire an employee for night irrigation.

Disadvantage:

1. The cost for repairs, parts, and replacement equipment can be quite high after five to ten years.

Semiautomatic Irrigation System

This type of system involves valves that respond directly to a manually operated remote control switch. Such a system is installed in a golf course where long-range plans call for conversion to a fully automatic system when additional monies are available.

Advantage:

1. There is a low initial cost with potential for future upgrading.

Disadvantage:

1. Labor costs are higher than with an automoatic system.

There are three variations of a semiautomatic system:

1. Only the pop-up sprinkler heads and control valves are permanently installed. Irrigation operations are conducted manually.
2. Quick coupler sprinkler heads are manually engaged into selected quick coupler valves in those locations where irrigation is required. The heads are then activated through valves and automatic controllers.
3. A portion of the course, such as greens, is designed with a fully automatic system, while other areas such as fairways are equipped with a semiautomatic system.

Manual Quick Coupler System

A quick coupler system requires the manual insertion and removal of each sprinkler head into quick coupling valves positioned at appropriate locations on the golf course. The quick coupler sprinkler irrigation head is activated immediately and operates continuously until the head is manually removed.

Advantage:

1. The initial cost is lowest of the three systems.

Disadvantages:

1. From one to three night irrigators are usually employed for operation of the system.
2. A greater amount of water is used due to human error.

INFORMATION SHEET #11

Careers in Golf Course Management

Golf Course Superintendent

Definition — A golf course superintendent is responsible for development and management of a golf course. The responsibilities include construction and maintenance of the golf course, supervision of the servicing and repair of turf grass maintenance and construction equipment, keeping appropriate records, and preparing budgets and reports.

Prerequisites:

1. A degree in agronomy/horticulture/plant/soil sciences or equivalent knowledge is desired.
2. Experience in all phases of golf course management and turf culture.
3. Certified and/or licensed in pesticide usage.
4. Knowledge of the game of golf.
5. Knowledge of construction.
6. Ability to train, motivate, and effectively direct.

Assistant Golf Course Superintendent

Definition — Under the general supervision of the golf course superintendent, the assistant superintendent directs and participates in the construction and maintenance of a golf course. The assistant also supervises the operation, maintenance, and repair of motorized and mechanized equipment.

Prerequisites:

1. Degree in agronomy/horticulture/plant/soil sciences is desired.
2. Certified or licensed in pesticide usage.
3. Knowledge of the game of golf.
4. Knowledge of construction establishment and maintenance practices employed on the golf course.
5. Ability to schedule and supervise work to achieve the most efficient utilization of employees and equipment.

Golf Course Maintenance Supervisor

Definition — Under the general supervision of the superintendent or assistant superintendent, the maintenance supervisor assists in directing and participates in construction and maintenance of the golf course, and performs related tasks required.

Prerequisites:

1. Ability to direct and take an active part in golf course construction and maintenance activities.

Equipment Mechanic

Definition — Under direction, the equipment mechanic makes major and minor mechanical repairs on a variety of gasoline and diesel powered equipment. The mechanic also keeps all equipment in efficient, operable condition. The mechanic must maintain a clean service area and maintenance building.

Prerequisites:

1. Working knowledge of light and heavy construction and maintenance equipment.
2. Skill in the use of a wide variety of equipment repair tools.
3. Knowledge of the theory, care, and operation of the internal combustion engine.
4. Ability to diagnose mechanical troubles and schedule appropriate preventative maintenance work.

Equipment Operator

Definition — Under direction, the equipment operator operates motorized equipment and trucks used on the golf course and does related tasks required.

Prerequisites:

1. Knowledge of safe, efficient mechanical operation of trucks and other motorized equipment.
2. Mechanical aptitude.
3. Ability to follow oral and written directions.

Green Staff Member

Definition — Under supervision, the green staff member works in the diverse range of activities involved in golf course maintenance and construction, does semiskilled grounds construction and maintenance work, and performs related tasks as required.

Prerequisites:

1. Knowledge of tools, methods, and materials used in golf course and grounds landscape construction and maintenance work.
2. Ability to safely operate trucks and motorized equipment.
3. Ability to follow oral and written directions.

Landscape Gardener

Definition — Under supervision, the landscape gardener is responsible for the care and maintenance of the ornamental plants, shrubs and trees on the clubhouse grounds and selected golf course sites. The landscape gardener also operates equipment associated with the maintenance of ornamental plants.

Prerequisites:

1. Knowledge of the characteristics and cultural requirements of ornamental plants, shrubs, and trees, and proper use of fertilizers, soil conditioners, and pesticides.
2. Ability to safely operate trucks and motorized equipment.
3. Ability to follow oral and written directions.

Irrigation Specialist

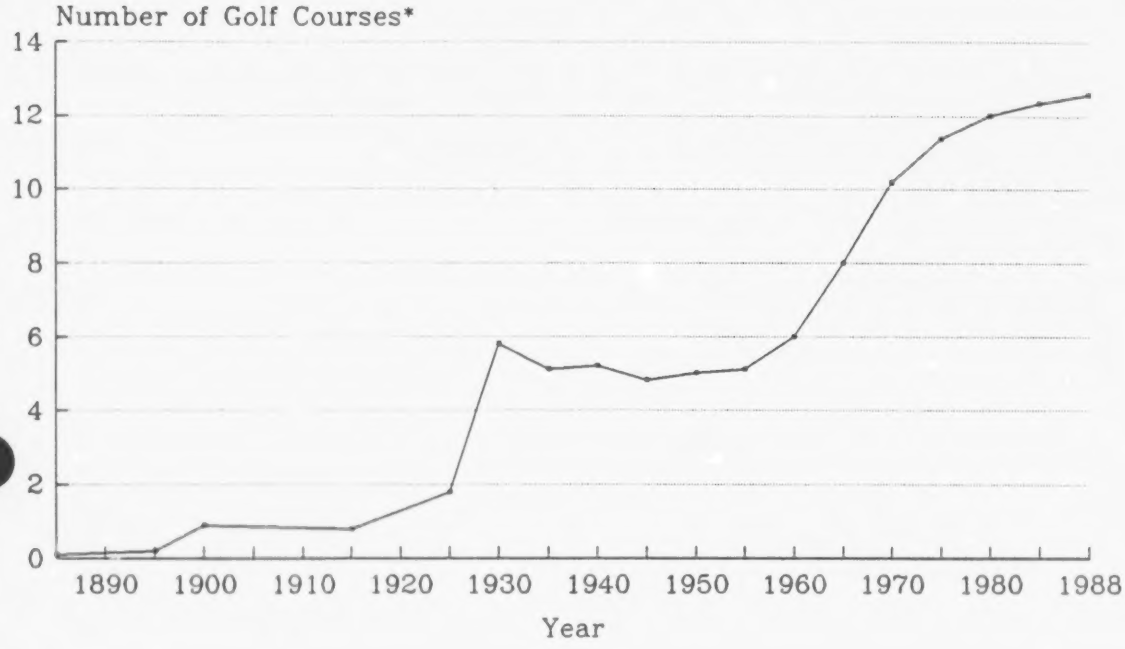
Definition — Under supervision of the superintendent or assistant superintendent, the irrigation specialist operates, services, and repairs the varied components of an irrigation system and performs related tasks required.

Prerequisites:

1. Working knowledge of basic electricity.
2. Working knowledge of basic hydraulics related to an irrigation system.
3. Working knowledge of automatic valves and controllers, and of various types of pumps and pumping systems.

TRANSPARENCY MASTER #1

Growth of Golf Course Facilities in the United States



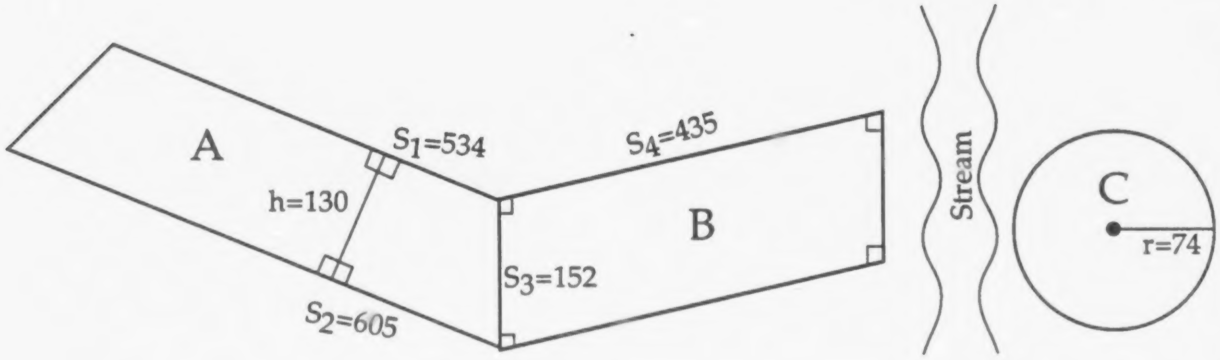
*in thousands

Growth of golf course facilities in the United States from 1888 to 1988. (Adapted from data provided by the National Golf Foundation, North Palm Beach, Fla. and Statistical Abstracts of the United States, 1990)

926

TRANSPARENCY MASTER #2

Area Measurement

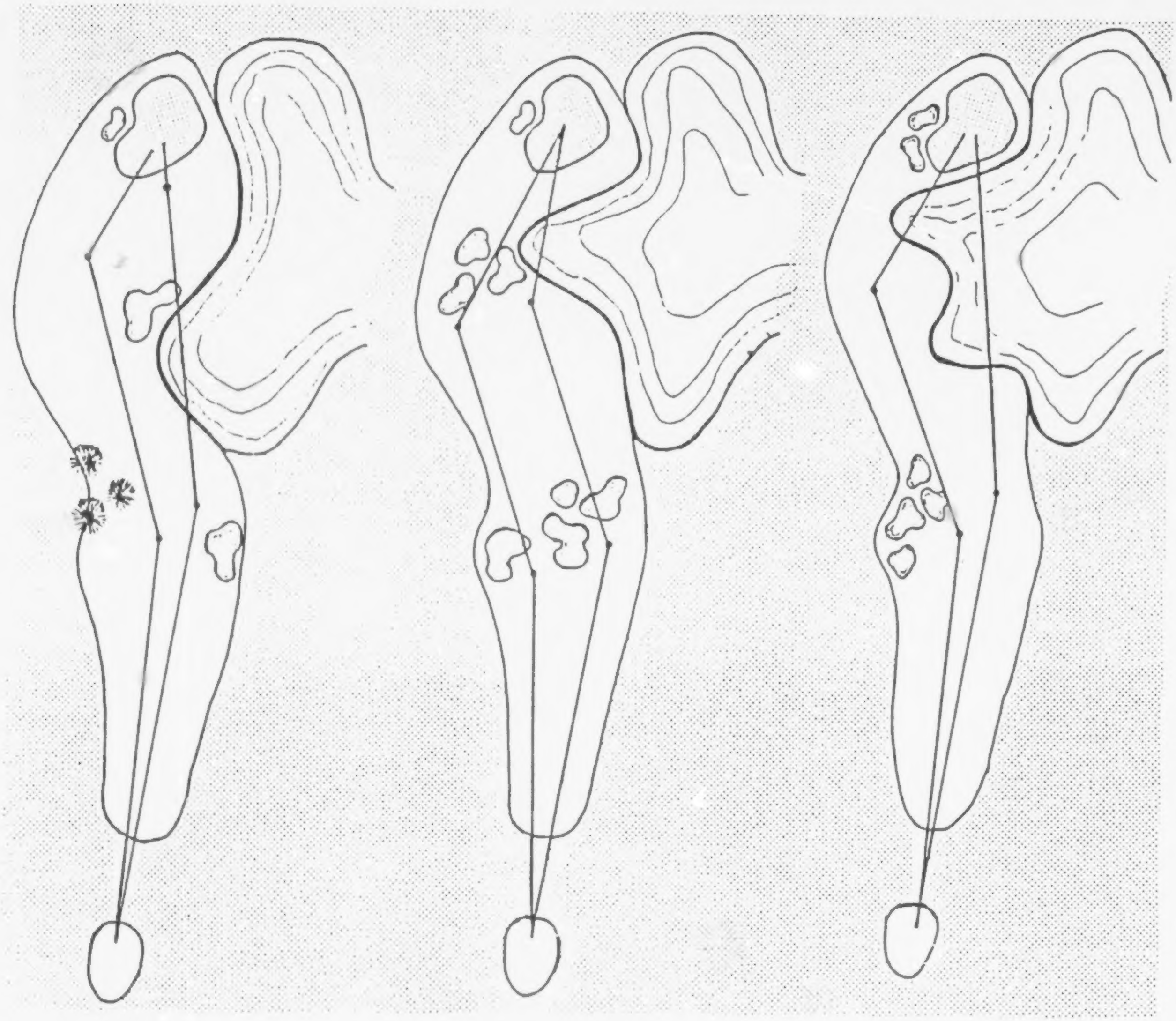

A
h=130
S_1=534
S_2=605
S_3=152
S_4=435
B
Stream
C
r=74

Area A = Trapezoid		Area B = Rectangle		Area C = Circle
$[(S_1 + S_2) \div 2] \times h$	+	$S_3 \times S_4$	+	πr^2
Total Area = $[(534 + 605) \div 2] \times 130$	+	(152×435)	+	$[3.14 \times (74)^2]$
Total Area = 74,035	+	66,120	+	17,195

Total Area = 157,350 sq. ft. or 157,350 ÷ 43,560 = 3.6 acres

TRANSPARENCY MASTER #3

Course Design



Strategic **Penal** **Heroic**

Adapted from : *Turf Management for Golf Courses.*

TRANSPARENCY MASTER #4

Putting Green

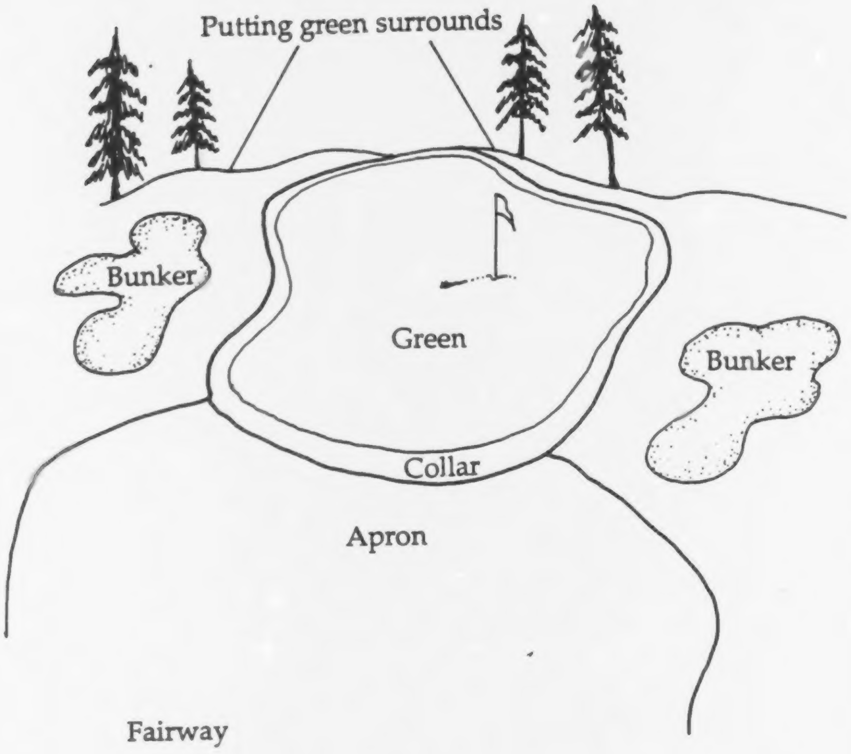
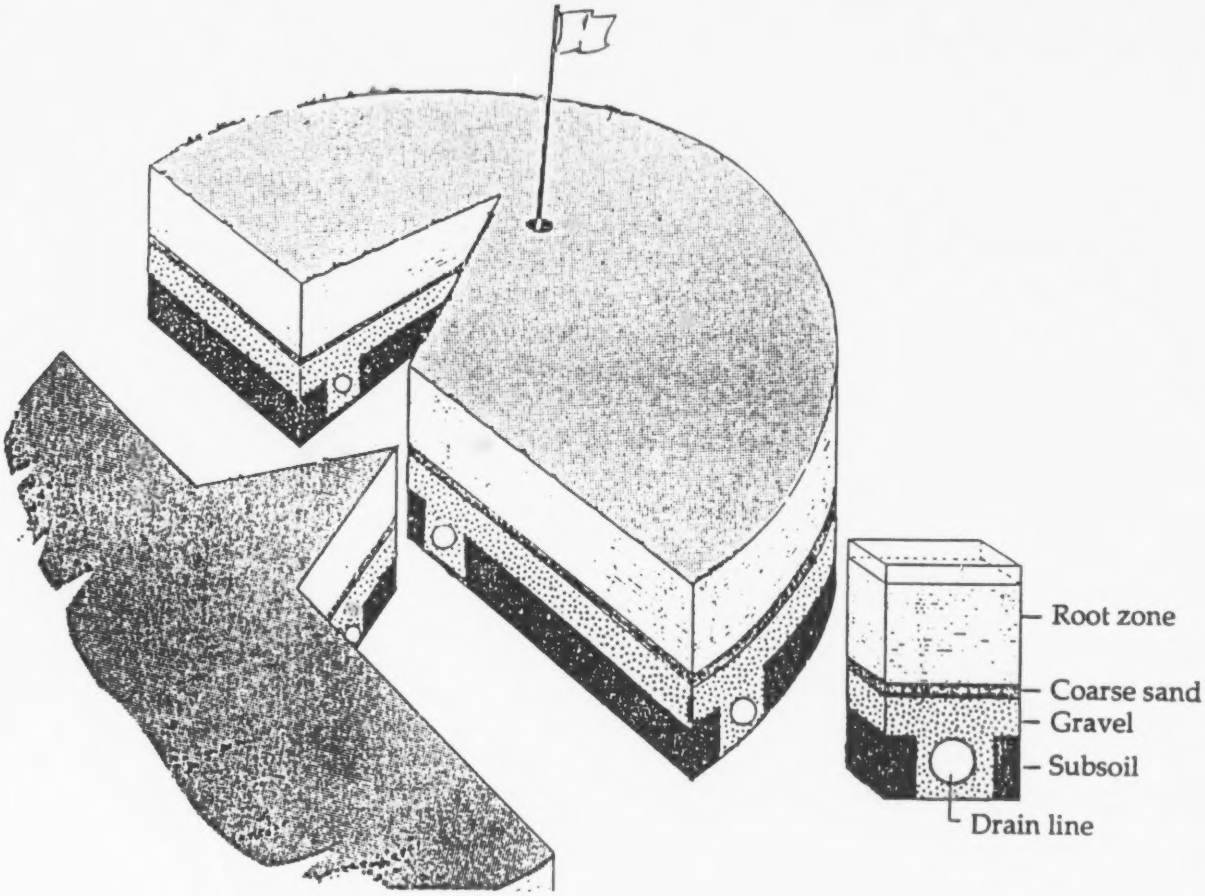

Putting green surrounds
Bunker
Green
Bunker
Collar
Apron
Fairway

Illustration of a putting green with the associated collar, apron, and grassy surrounds.

Adapted from : *Turf Management for Golf Courses.*

TRANSPARENCY MASTER #5

Putting Green Cross-Section

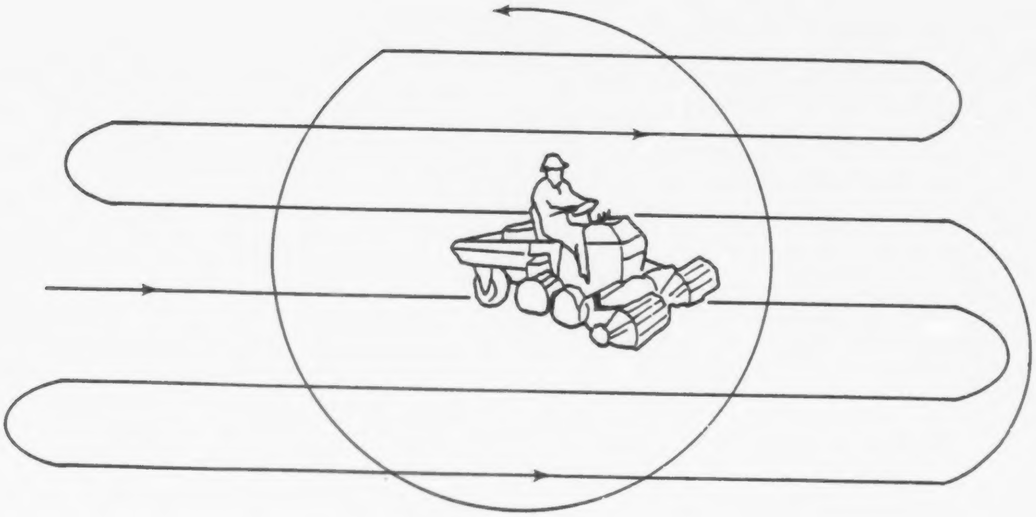

Root zone
Coarse sand
Gravel
Subsoil
Drain line

Cross section showing United States Golf Association Green Section method of putting green construction.

Adapted from : *Turf Management for Golf Courses.*

TRANSPARENCY MASTER #6

Mowing a Green



Preferred pattern of three-gang greensmower operation for a green.

Adapted from : *Turf Management for Golf Courses*.

TRANSPARENCY MASTER #7

Mowing Practices Utilized on Golf Course Fairways

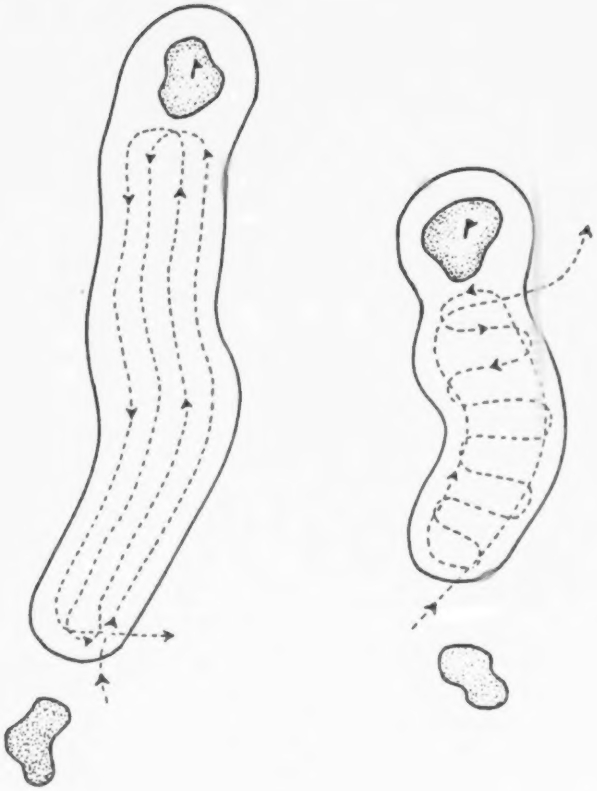
Turf grass Species	Cutting Height* (in.)	Cutting Height* (cm.)	Interval of Days Between Mowing**
Annual bluegrass, intensively irrigated	½-¾	1 - 2	2 - 3
Bentgrass, irrigated	½-¾	1¼ - 2¼	2 - 3½
Bermudagrass:			
Irrigated	½-¾	1¼ - 2	2 - 3½
Not irrigated	¾ - 1	1¾ - 2½	7 - 14
Buffalograss	¾ - 1	1¾ - 2½	7 - 21
Fine-leafed, fescues, very limited irrigation	¾ - 1	1¾ - 2½	7 - 21
Kentucky bluegrass:			
Irrigated	½ - 1	1¾ - 2½	2 - 3½
Not irrigated	1 - 1¼	2½ - 3	7 - 14
Kikuyugrass, irrigated	½-¾	1 - 2½	2
Zoysiagrass, irrigated	½ - 1	1 - 2½	2 - 3½

*Effective cutting height.

**Frequency interval shortens as nitrogen or irrigation levels are increased. Two-day interval would be from Monday to Wednesday.

TRANSPARENCY MASTER #8

The Fairway

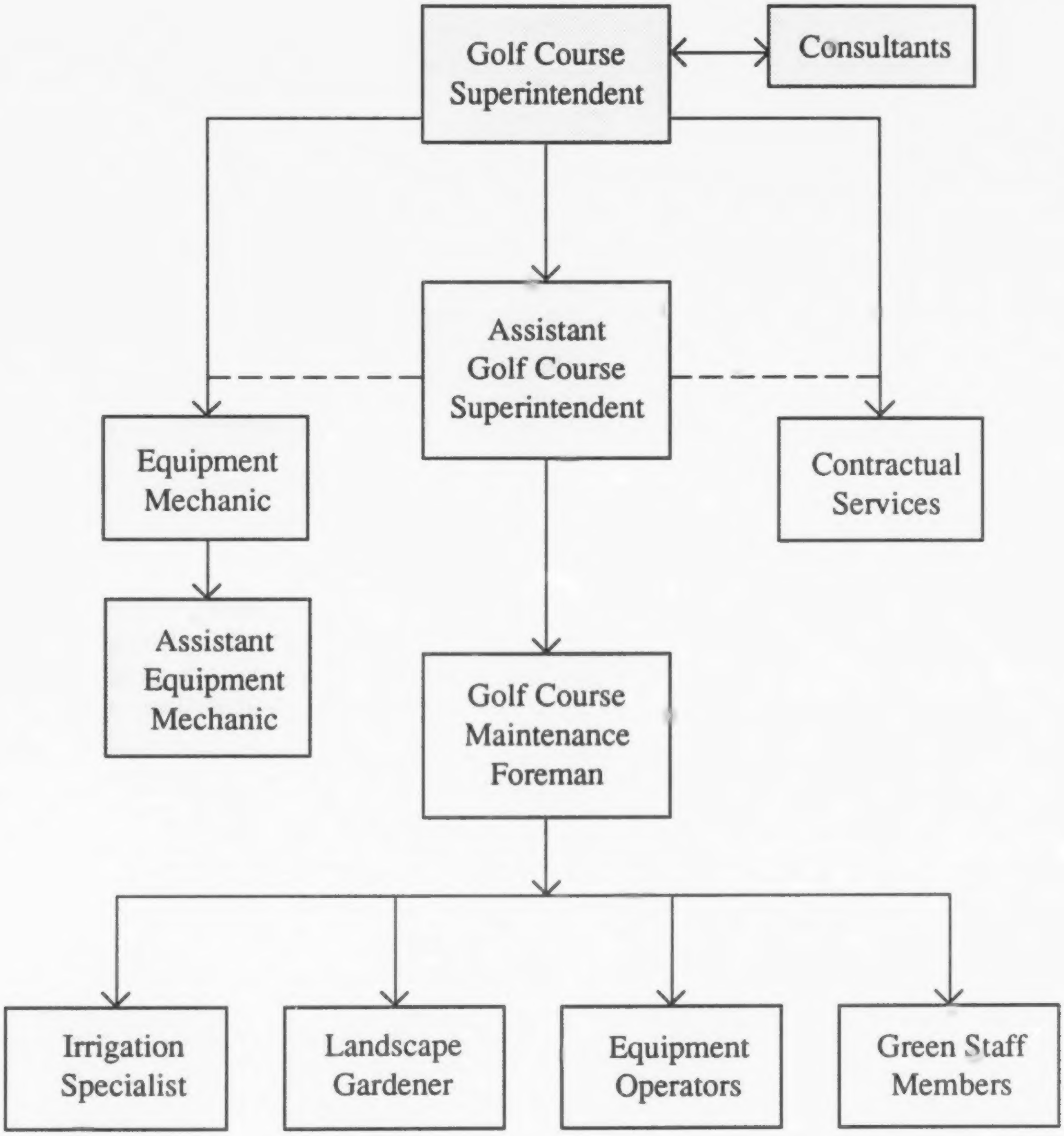


Suggested mowing patterns for a fairway: longitudinal (left), cross pattern (right).

Adapted from : *Turf Management for Golf Courses.*

TRANSPARENCY MASTER #9

Hierarchy of Management



Golf Course Superintendent

Consultants

Assistant Golf Course Superintendent

Equipment Mechanic

Contractual Services

Assistant Equipment Mechanic

Golf Course Maintenance Foreman

Irrigation Specialist

Landscape Gardener

Equipment Operators

Green Staff Members

STUDENT ACTIVITIES

STUDENT WORKSHEET #1 — Area Measurement Questions

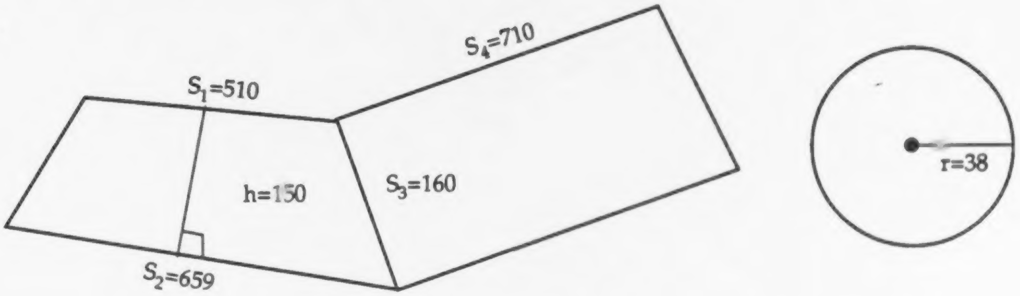
For additional activities, teachers may refer to the "Suggested Teaching Activities and Procedures" section in the Instructor's Guide.

STUDENT WORKSHEET #1

Area Measurement Questions

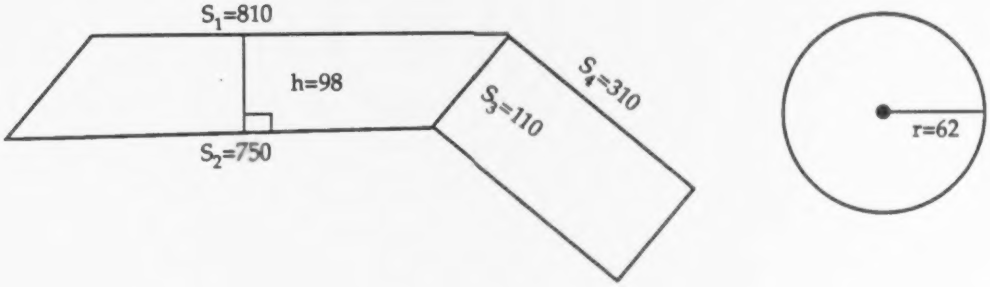
For each hole, figure the total area.

1.



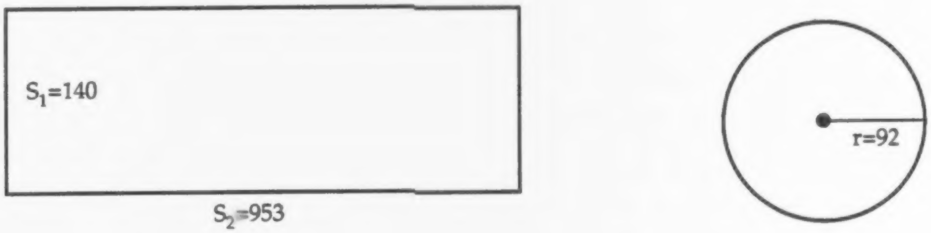
S_1=510
S_4=710
h=150
S_3=160
S_2=659
r=38

2.



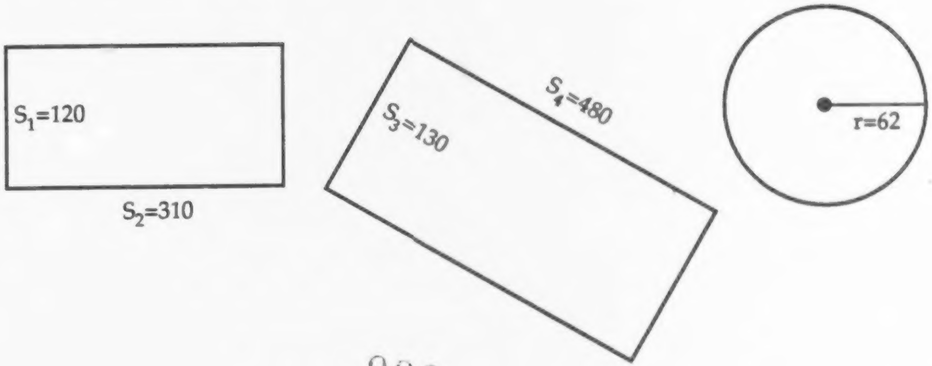
S_1=810
h=98
S_4=310
S_3=110
S_2=750
r=62

3.



S_1=140
S_2=953
r=92

4.



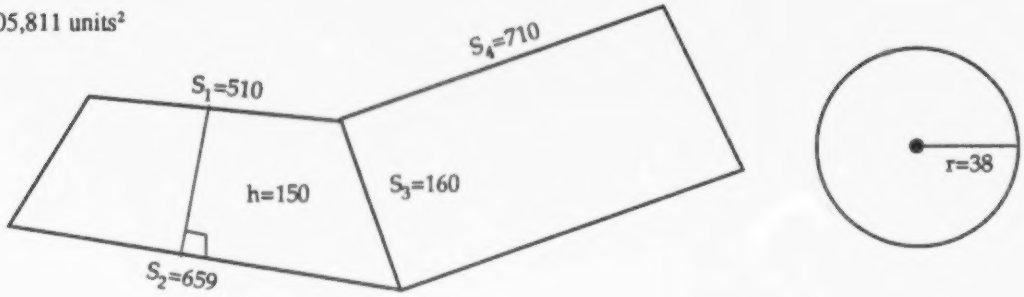
S_1=120
S_2=310
S_4=480
S_3=130
r=62

STUDENT WORKSHEET #1 — Key

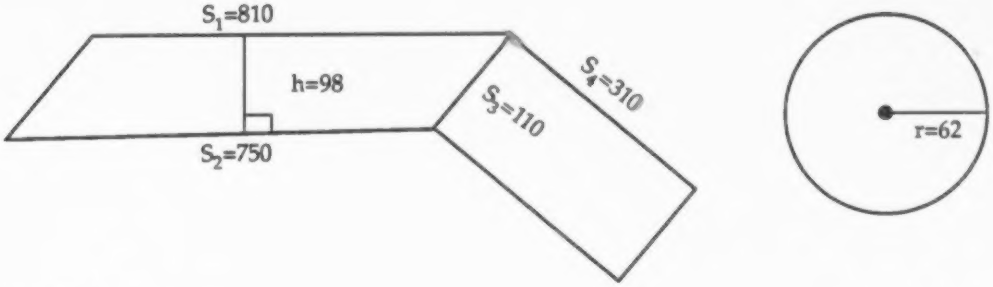
Area Measurement Questions

For each hole, figure the total area.

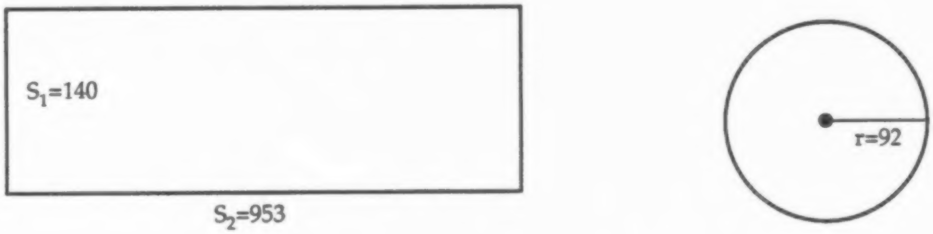
1. 205,811 units²


$S_1=510$
$S_4=710$
h=150
$S_3=160$
$S_2=659$
r=38

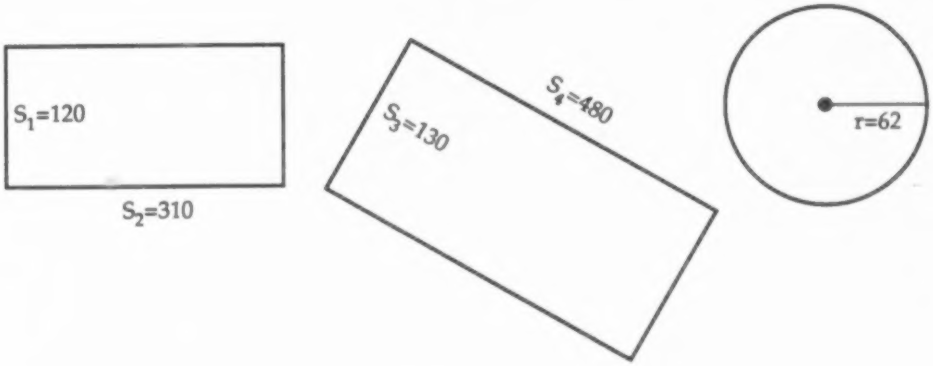
2. 122,616 units²


$S_1=810$
h=98
$S_4=310$
$S_3=110$
$S_2=750$
r=62

3. 160,010 units²


$S_1=140$
$S_2=953$
r=92

4. 111,676 units²


$S_1=120$
$S_2=310$
$S_4=480$
$S_3=130$
r=62

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Outdoor Recreation

PROBLEM AREA: Managing Parks and Recreational Areas

RELATED PROBLEM AREAS:

1. Conserving Water Resources
2. Controlling Air Pollution
3. Managing Land Resources
4. Processing Forest Products
5. Maintaining Wildlife Habitat
6. Managing Game Preserves
7. Basic Agribusiness Principles and Skills — Unit D (Central Core Cluster)
8. Agribusiness Operation and Management — Unit A (Agricultural Business and Management Cluster)

PREREQUISITE PROBLEM AREA(S):

1. Managing Forestry Resources
2. Managing Freshwater Resources
3. Adhering to Laws and Regulations

LEVEL: Preparatory

OCCUPATIONAL TASKS ADDRESSED:

Duty A: Managing the Recreational Facility

1. Complete weekly receipts
2. Complete invoices
3. Requisition materials, supplies and services
4. Maintain inventory records
5. Maintain equipment maintenance records
6. Follow work schedule
7. Contribute to annual park management update
8. Identify specific recreational program needs for visitors
9. Complete business forms
10. Communicate orally with visitors
11. Assist in assessing and collecting fees and charges
12. Determine land-use capability
13. Assist in development of resource conservation plans
14. Interpret maps, charts and aerial photographs

Duty B: Applying Laws, Regulations, and Policies

1. Interpret visitor disciplinary processes
2. Interpret game and wildlife laws
3. Interpret stream, lake, pond, and groundwater laws
4. Patrol park areas
5. Request visitors to voluntarily comply with rules and regulations
6. Process visitor complaints
7. Report violations to appropriate authority
8. Interpret Environmental Protection Agency (EPA) regulations
9. Maintain permits, certificates, and licenses
10. Maintain crowd control
11. Direct vehicular and pedestrian traffic
12. Greet and meet people
13. Prepare service work order
14. Estimate cost of service work
15. Post facility directions and warnings
16. Post facility rules and regulations
17. Monitor camping and swimming areas
18. Maintain wildfire protection laws
19. Maintain facility sanitation

Duty C: Performing Promotional Activities

1. Conduct a visitors' program and tour
2. Register visitors
3. Give information and directions in a variety of formal and informal settings
4. Implement environmental education programs
5. Identify recreational needs and interests of specific individuals and groups
6. Lead or guide recreational activities
7. Stimulate interest and participation in recreational activities for specific groups

Duty D: Managing Facility Flora and Fauna

1. Identify plant communities and dominant species within a selected area
2. Identify native plant selections within a selected area
3. Apply pesticides
4. Identify wildlife species within a selected area
5. Identify endangered or exotic species of plant and animal life in a selected area
6. Monitor an ecological burn

STATE GOALS FOR LEARNING

In planning the instruction for this problem area, teachers can promote the development of several student learning objectives which are related to the State Goals for Learning in Social Sciences. These objectives are listed on the Learning Assessment Plan forms included on the following page(s). Those learning objectives marked with an asterisk (*) are taken from the sample lists provided by the Illinois State Board of Education.

Illinois Agricultural Core Curriculum
Agricultural Education 124 Mumford Hall 1301 W. Gregory Drive University of Illinois Urbana, IL 61801

Director: Dale A. Law, Ed.D.
Principal Investigator: Jerry D. Pepple, Ed.D
Research Assistant: Kevin J. Enderlin

940

Submission Date____________________

☐ **Original submission** ☐ **Revision**

Page ____ of ____

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

(Affix label or complete district information.)

COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐

District Name

City

I. LEARNING AREA *(check one)*

☐ Language Arts ☐ Fine Arts
☐ Mathematics ☒ Social Sciences
☐ Sciences ☐ Physical Development/Health

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will be able to demonstrate a knowledge of world geography with emphasis on the United States.

Contact Person: ____________________
Title: ____________________
Phone: (   )

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Know the relationship between the economic and social activities of a place and its physical geography.					
*2. Know the reasons for different kinds of land use.					
*3. Understand how habitats have been modified by human activity.					
4. Develop and discuss objectives for outdoor recreation.					
5. List and discuss the social and economic forces which affect outdoor recreation.					
6. Discuss how supply and demand affect outdoor recreation resources.					

ISBE 41-78 (1/88)

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

Submission Date ____________
☐ Original submission ☐ Revision
Page ____ of ____

I. LEARNING AREA *(check one)*
☐ Language Arts ☐ Fine Arts
☐ Mathematics ☒ Social Sciences
☐ Sciences ☐ Physical Development/Health

(Affix label or complete district information.)
COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐
District Name
City

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will be able to apply the skills and knowledge gained in the social sciences to decision making in life situations.

Contact Person: ____________
Title: ____________
Phone: (   )

III. LEARNING OBJECTIVES	IV. ASSESSMENT				V. EXPECTATIONS
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Compare the economic interdependence among agriculture, business, government, labor, and the consumer.					
*2. Understand the knowledge and skills required for success in selected fields of work.					
*3. Recognize that competence in a field of work entails the development of a wide range of skills.					
4. Identify federal agencies involved in outdoor recreation.					
5. List and discuss the social and economic forces which affect outdoor recreation.					
6. Discuss the state's role in outdoor recreation.					
7. List ways to generate funding for financing recreational areas.					

Managing Parks and Recreational Areas

Agricultural Resources
Outdoor Recreation

Submission Date ____________________
☐ **Original submission** ☐ **Revision**
Page ____ of ____

ILLINOIS STATE BOARD OF EDUCATION
Department of School Improvement Services
100 North First Street
Springfield, Illinois 62777-0001

LEARNING ASSESSMENT PLAN

Instructions and codes for this form are provided on a separate sheet.

(Affix label or complete district information.)

COUNTY ☐☐☐ DISTRICT ☐☐☐☐ ESC ☐☐

District Name

City

I. LEARNING AREA *(check one)*
☐ Language Arts ☐ Fine Arts
☐ Mathematics ☒ Social Sciences
☐ Sciences ☐ Physical Development/Health

II. STATE GOAL FOR LEARNING

As a result of their schooling, students will be able to understand and analyze comparative political and economic systems, with an emphasis on the political and economic systems of the United States.

Contact Person: ____________________
Title: ____________________
Phone: ( )

III. LEARNING OBJECTIVES	**IV. ASSESSMENT**				**V. EXPECTATIONS**
By the end of grade *(circle one)* 3 6 8 [✓ 11] students should be able to:	A Types	B Validity/ Reliability	C Commercial Test(s)	D Evidence of Nondiscrimination	Percent of Students Expected to Achieve Objective
*1. Analyze the principal elements in the concept of scarcity including unlimited wants, limited resources, and opportunity cost.					
2. Discuss the significance of time and leisure as they relate to recreation.					
3. Develop and discuss objectives for outdoor recreation.					
4. List and discuss the social and economic forces which affect outdoor recreation.					
5. Discuss how supply and demand affect outdoor recreation resources.					

Illinois Agricultural Core Curriculum Rev.

Managing Parks and Recreational Areas

Agricultural Resources
Outdoor Recreation

ISBE 41-78 (1/88)

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Outdoor Recreation

PROBLEM AREA: Managing Parks and Recreational Areas

STUDENT LEARNING OBJECTIVES

Upon completion of their study of this problem area, students will be able to:

1. Discuss the significance of time and leisure as they relate to recreation.
2. Identify the four types of leisure time.
3. Develop and discuss objectives for outdoor recreation.
4. Identify the four parts of the total recreational experience.
5. Discuss the values of outdoor recreation.
6. List and discuss the social and economic forces which affect outdoor recreation.
7. Understand the historical evolvement of outdoor recreation.
8. Identify federal agencies involved in outdoor recreation.
9. Discuss the state's role in outdoor recreation.
10. Discuss how supply and demand affect outdoor recreational resources.
11. Identify the economic impact of outdoor recreation.
12. List ways to generate funding for financing recreational areas.
13. Discuss how liability insurance affects outdoor recreational areas.

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Outdoor Recreation

PROBLEM AREA: Managing Parks and Recreational Areas

PROBLEMS AND QUESTIONS FOR STUDY	**INSTRUCTOR'S NOTES AND REFERENCES**
1. What is leisure time?	
2. What is recreation?	
3. What are the classifications of recreational pursuits?	
4. How many types of leisure time are there?	
5. What should be the objectives for outdoor recreation?	
6. What makes up a total recreational experience?	
7. What are the values of outdoor recreation?	
8. What factors affect outdoor recreation?	
9. What are some historical developments that have affected outdoor recreation?	
10. What federal agencies are involved in outdoor recreation?	
11. What state agencies are involved in outdoor recreation?	
12. How does supply and demand affect the types of recreational experiences available?	
13. What is the economic impact of outdoor recreation?	
14. How can outdoor recreational areas be financed?	
15. How does liability affect outdoor recreational area management?	

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Outdoor Recreation

PROBLEM AREA: Managing Parks and Recreational Areas

SUGGESTED TEACHING ACTIVITIES AND PROCEDURES	INSTRUCTOR'S NOTES AND REFERENCES
1. Visit a park or recreational area in the local community.	
2. Write a state or federal agency related to outdoor recreation and ask for information about the purpose of their agencies and the programs they do.	
3. Invite a person employed in the field of outdoor recreation into the classroom to speak to the students.	
4. Select a site in the community that could be developed into an outdoor recreational area and have students develop an implementation plan.	
5. Use the Central Core Cluster, Unit D, "Basic Agribusiness Principles and Skills," and the Agricultural Business and Management Cluster, Unit A, "Agribusiness Operation and Management," as resources for information, practices, principles, and techniques of organizing, marketing, financing, operating, insuring, and managing that are common to all ventures of business. These concepts can be combined with the specific goals of parks and recreational areas to form the practices necessary for sustainable operation.	

INSTRUCTOR'S GUIDE

CLUSTER: AGRICULTURAL RESOURCES

UNIT: Outdoor Recreation

PROBLEM AREA: Managing Parks and Recreational Areas

REFERENCES

1. *Creative Management in Recreation and Parks.* Kraus, Richard G., Curtis, Joseph E. C.V. Mosby Company, 11830 Westline Industrial Drive, St. Louis, MO 63146. (314) 872-8370, (800) 633-6699.

*2. *Outdoor Recreation and Resource Management.* Pigram, John. St. Martin's Press, Inc., 175 Fifth Avenue, New York, NY 10010. (212) 674-5151, (800) 221-7945.

*3. *Park Management.* McCurdy, Dwight R. Southern Illinois University Press, P.O. Box 3697, Carbondale, IL 62902-3697. (618) 453-2281.

*Indicates highly recommended reference

INSTRUCTOR'S NOTES AND REFERENCES

INSTRUCTIONAL RESOURCES

These resources are intended for use by teachers in planning and teaching the materials for this problem area and may be adapted to fit the teaching method(s) used.

INFORMATION SHEET #1 — Leisure and Recreation

INFORMATION SHEET #2 — Types of Leisure Time

INFORMATION SHEET #3 — Objectives of Outdoor Recreation

INFORMATION SHEET #4 — The Total Recreational Experience

INFORMATION SHEET #5 — Values of Outdoor Recreation

INFORMATION SHEET #6 — Social and Economic Forces Which Affect Outdoor Recreation

INFORMATION SHEET #7 — History of Outdoor Recreation in the United States

INFORMATION SHEET #8 — Federal Agencies Involved in Outdoor Recreation

INFORMATION SHEET #9 — Role of the State in Outdoor Recreation

INFORMATION SHEET #10 — Supply and Demand of Outdoor Recreation

INFORMATION SHEET #11 — Economic Impact of Outdoor Recreation

INFORMATION SHEET #12 — Financing Recreational Areas Terms to be Defined

INFORMATION SHEET #13 — Liability and Insurance

TRANSPARENCY MASTER #1 — The Diffusion of Leisure Time

TRANSPARENCY MASTER #2 — Population Growth of the United States

TRANSPARENCY MASTER #3 — World Population Growth

TRANSPARENCY MASTER #4 — Percentage of United States Population Living in Urban Environments

TRANSPARENCY MASTER #5 — Changes in Average Work Week in America Among Nonfarm Workers

TRANSPARENCY MASTER #6 — Predicted Increases in Outdoor Recreation Participants

TRANSPARENCY MASTER #7 — Participation in Outdoor Recreation

TRANSPARENCY MASTER #8 — Visits to State Parks in the United States

INFORMATION SHEET #1

Leisure and Recreation

Leisure

Leisure time is unobligated time, free time, or spare time; time when one is free to do as one chooses. Time can be divided into three classes:

1. Time for existence — Biological requirements, such as sleeping, eating, and sanitation.
2. Time for subsistence — Economic requirements, such as working on a job.
3. Leisure time — The time remaining after a minimum level of existence and subsistence have been accomplished.

Typical American Adult
Classification of Time
24 Hour Scale

Existence (biological requirements)	Subsistence (work)	Leisure Time
10	9 (includes travel time)	5

Significance of Time and Leisure

The amount of free time people have and how they use it is of great significance. Individuals, communities, and nations are made and unmade by the way they use free time. The basic problem associated with increased leisure time is that it is not inherently good or bad, but has great potential for either. Leisure is simply a key which unlocks a new door but brings no guarantee of improved individuals or a better society. Leisure time that is available to an individual will influence his or her life. And if it is present on a large scale in a society, it will strongly influence the molding of that society. We cannot eliminate the influence of leisure time, but we can determine the quality of its influence by making wise decisions.

Recreation

Recreation may be considered as any form of leisure-time experience or activity in which an individual engages from choice because of enjoyment and satisfaction which it brings directly to him or her.

Recreation is the pleasurable and constructive use of leisure time.

Recreation is any socially desirable leisure activity in which an individual participates voluntarily and from which he or she derives immediate and continuing satisfaction.

The following elements are common to all recreational activities:

1. Recreation directly involves the individual.
2. It is entered into voluntarily.
3. It occurs during leisure time.
4. The motivating force is enjoyment and satisfaction, as opposed to material gain.
5. Recreation is wholesome to the individual and his or her society.

Classification of Recreational Pursuits

1. Resource-oriented recreation — Resource-oriented recreation includes those forms that depend strongly on the utilization of natural resources, such as the study of botany and wildlife, camping, hiking, fishing, boating, and hunting. Outdoor recreation is a commonly used term meaning the same thing as resource-oriented recreation. Outdoor recreation is defined as those recreational activities which occur in an outdoor (natural) environment and which relate directly to the environment.
2. Activity-oriented recreation — Activity-oriented recreation includes the performance or witnessing of a performance such as athletics, dramatics, art, music, crafts, and so on.

INFORMATION SHEET #2

Types of Leisure Time

Daily leisure — Usually broken up into small segments of an hour here and an hour there. Most is available in evenings after the termination of the work day. This allows for participation in only short-duration activities and leaves much to be desired with respect to new experiences and activities.

Weekly leisure — Usually defined in terms of weekends. We think of this in terms of two whole days, a large enough block of time to engage in long-term projects or to take a short trip away from home. Weekend leisure is often interrupted by daily chores postponed during the week.

Vacation leisure — This represents a large block of time given annually which workers feel they have earned by a year of labor. To most American workers the vacation period represents a segment of the year when time is not the greatest limitation. This period allows time to travel or become involved in some extensive project.

Retirement leisure — For many people retirement leisure represents a period when time is more abundant than any other aspect of their life. They can therefore pursue whatever interests are within their means.

INFORMATION SHEET #3

Objectives of Outdoor Recreation

Objectives are the goals toward which a program is pointed, serving as guides, adding purpose and direction. It seems that the objectives of most agencies dealing with outdoor recreation have been developed with little long-range planning, but have merely attempted to meet the desires of public demand. If outdoor recreation is an area of great public interests and public spending, then some guiding purposes must be stated. The objectives of outdoor recreation in America should include at least the following:

1. Develop an appreciation of nature — Today the majority of our urban residents have very limited opportunities to experience nature. They have little chance to develop a knowledge of and appreciation for nature. Without such a knowledge and appreciation, it is difficult for people to become interested in the conservation and preservation of natural resources.

2. Enhance individual satisfaction and enjoyment — People participate in outdoor recreation primarily for enjoyment. This contributes to happiness. Each agency involved in outdoor recreation should develop a program of identifying and developing those resources which have unusual potential for creating in people a feeling of satisfaction and well-being.

3. Provide opportunity for diversion and relaxation — For the most part people go to the outdoors to divert themselves from their usual rapid pace, routine patterns, and the restrictions under which they normally live. Agencies should help them to achieve such diversion. This will become more difficult as the number of users continues to increase at a rapid pace.

4. Develop physiological fitness — The increasing lack of physical fitness has been recognized as one of the crucial problems facing American society. Many forms of outdoor recreation increase a person's physical fitness. For instance, hiking, swimming, hunting, fishing, skiing, and camping often provide unusual physical challenges.

5. Develop desirable behavioral patterns — There was a time when an individual going to the great outdoors was alone, but for the most part those days are gone. Today's outdoor participant finds many people wherever he or she goes. The fact that today's outdoor recreationist must share his or her resources with many other people, requires the development of desirable patterns of social outdoor conduct.

INFORMATION SHEET #4

The Total Recreational Experience

One would think that a recreational experience occurs during the time of participation in the activity. Upon closer evaluation, it becomes apparent that the total experience extends far beyond the time of actual participation. The value and usefulness of the experience may be a part of a person's life long before, and remaining long after, the participation itself. A total recreational experience includes the following four phases:

1. The anticipation phase - Anticipation is that time during which the person foresees the greatness of the coming event. It is the time of anxiously awaiting the day when the experience will become a reality.
2. The planning phase - Planning involves the actual preparation for the coming event. Planning involves the gathering of equipment and supplies, preparation of food and clothes, and other necessary matters.
3. Participation phase - Participation is the period of actual activity and the duration of the event. It extends from the time of departure to the time of return.
4. Recollection phase - Recollection may take the form of thought, expression in written or oral form, or displaying pictures, slides or movies. This phase is thinking, telling, and showing about the direct experiences that have occurred.

INFORMATION SHEET #5

Values of Outdoor Recreation

1. Cultural values — Throughout history people have gradually added beauty to utility. The first pots, tools, and huts were made for survival. As time progressed, a touch of decoration was added. As civilization progressed, pots became known more for their beauty than their utility. The same pattern followed for architecture, clothing, and many other things created and used by people. There was a time in history when our natural resources were valued only for the economic values of the products produced from them. Over a period of time, priority of beauty over utility has occurred in the use of certain resources.

2. Psychological values — One of our greatest comforting influences comes from being in contact with nature. The wholeness of life, the awareness of interactions and interrelationships, and the balance of nature are all important in our lives.

3. Sociological values — In most people there exists a drive for adventure, excitement, and challenge. If this drive is not satisfied by high-quality activities, then it will be satisfied by less desirable, unsocial areas. Another social aspect of outdoor activities is that people of like interests draw closer together, causing them to develop friendships. Often, a person's circle of friends is developed around a special recreational interest. A third aspect is learning desirable behavior and conduct. Learning to keep camp and picnic areas clean, and to be considerate of the rights and enjoyment of others are important social attributes.

4. Physical values — A nation is no stronger than its people. The physical vigor of people is as much a part of a nation's strength as a good education. In our present state of living, it is difficult to keep the body in good condition. Those who participate regularly in outdoor recreational activities generally improve their fitness.

5. Educational values — The outdoors provides a part of education that strengthens people's minds and bodies, that broadens their understanding of the laws of nature, and that sharpens their appreciation for natural beauty. Some of the specific educational values that may be obtained through outdoor experiences are an awareness and observation of:

   a. Life's processes and their great variety.

   b. Geological formations and the content of rock and soil.

   c. The importance and practice of conservation.

   d. Beautiful scenery and the joy of experiencing it.

   e. One's own self through being somewhat alone with nature.

   f. Good outdoor manners.

   g. The benefit of mastery of outdoor skills.

6. Spiritual values — Outdoor experiences may enable a person to experience freedom and serenity, and develop humility, inner warmth, and a sense of security.

INFORMATION SHEET #6

Social and Economic Forces Which Affect Outdoor Recreation

The society in which we live changes rapidly. In our society change influences the lives of the people in it. In particular, it affects our time, leisure, and recreational patterns. Living in the presence of constant change is difficult. In the past most people were able to go through life with a set of attitudes and beliefs appropriate to the age in which they were born. Never before has an individual had to be so versatile, knowledgeable, perceptive, and adaptive to change as today. The following are social and economic factors that, as they change, affect outdoor recreation.

1. Population — The number of people living in a given area strongly influences their living patterns. This factor especially influences the use of natural resources. There is a point of population beyond which resources are unable to satisfy the demand for outdoor recreation.

2. Urbanization — In recent decades there has been a mass move from the rural environment to the urban environment. As a result, the accessibility of outdoor areas has become greatly restricted to a major portion of the population. The number of people living in urban areas is expected to double in the next 30 years. The open spaces currently surrounding cities will turn into suburban developments.

3. Mobility — Some say the most distinctive feature about life in America is mobility. Never before has a nation of people been able to travel as far and as fast with such ease. Our highly developed system of transportation can deliver large numbers of people to the doorsteps of every outdoor recreational area in the world.

4. Work and leisure time — In our society, as work becomes shorter, vacation periods become longer. Two-week vacations were once a rare privilege. But now the trend is vacations extending from three to five weeks. When we sum up the shorter work week, increased length of vacations, and earlier retirement, it is apparent that Americans today spend significantly less time on the job and more time at leisure than they spent 50 to 100 years ago.

5. Income — Additional income per individual and family has resulted in greater expenditures on all phases of life. But the greatest increase in spending has been on the nonessential goods (luxuries) as opposed to the necessities of food, clothing, and shelter. It is safe to predict that as income increases, people will spend more of their income on hobbies, sports, and other recreations.

6. Automation and technology — The most severe problem as a result of automation is unemployment. Automation and technology increase work efficiency and reduce the number of persons required to produce a product. If these problems are coped with and the benefits of automation retained, then men and women of the future will truly have a surplus of leisure and recreational time available.

INFORMATION SHEET #7

History of Outdoor Recreation in the United States

Early Developments

1626 — Colony of Plymouth passed an ordinance that prohibited cutting timber on the colony land without official consent.

1775 — Twelve of the 13 colonies had enacted closed seasons on certain game.

1799 — U.S. Congress appropriated $200,000 to purchase timberlands.

1871 — Congress passed a much-needed bill for the protection of bison.

1872 — In Nebraska, Arbor Day was declared to create an awareness of the need for trees in metropolitan areas.

1872 — Yellowstone National Park was reserved as a "pleasuring ground." This marked the beginning of the national park system in the United States.

1884 — The first association for the protection of game was formed in the state of New York.

1891 — President Harrison created the first national forest reserve.

1891 — Park Protection act was passed. It provided protection for wildlife in the national parks.

1899 — Congress passed a law that allowed the recreational use of forest reserves. This was the first law to recognize the recreational value of forests.

Early 1900s

1902 — Reclamation Act provided government aid to help develop water resources.

1902 — First national wildlife refuge was established on Pelican Island off the coast of Florida.

1905 — Bureau of Biological Survey was established. This was the predecessor of the U.S. Fish and Wildlife Service.

1906 — Antiquities Act paved the way for setting aside national monuments.

1906 — 15.6 million acres of forest reserve were added.

Post World War II years

1951 — Dingle-Johnson Act provided federal and state funds to state fisheries.

1951 — Watershed Protection and Flood Prevention Act authorized the Department of Agriculture to cooperate with state and local agencies in planning and carrying out improvements on small watersheds.

1954 — Recreation and Public Purposes Act authorized state and local governments and non-profit organizations to acquire certain federal lands for recreational use.

1958 — Congress established the Outdoor Recreation Resources Review Commission (ORRRC) for the purpose of surveying the outdoor recreational needs of the people.

1960 — Multiple-use Sustained Shield Act made outdoor recreation an official function of the national forest service.

1962 — Establishment of the Bureau of Outdoor Recreation within the Department of Interior.

1964 — Land and Water Conservation Fund Act was passed. This provided states with federal funds for planning, acquiring, and developing outdoor recreational areas.

INFORMATION SHEET #8

Federal Agencies Involved in Outdoor Recreation

The federal government has been involved with outdoor recreation since the Civil War days. Justification for federal government involvement is constituted in the Preamble and Article I of the constitution, where to "promote the general welfare" is listed as one of the purposes of government.

Federal functions in outdoor recreation include the management of federally owned properties such as parks, forests, wildlife preserves, and reservoir areas, and technical and financial assistance to state and local agencies and private citizens. Major outdoor recreation management agencies include:

1. National Park Service — The National Park Service of the United States comprises nearly 300 areas covering some 31 million acres. Types of national parks include:
    - natural areas
    - historical areas
    - recreational areas
    - wild and scenic rivers
    - performing arts facilities
    - national lakeshores and seashores
    - national parkways
2. United States Forest Service — As people gradually discovered the recreational values of forests and began to use them, the Forest Service found itself attempting to manage recreation in order to minimize fire hazards, stream pollution, and hazards to the recreationists themselves.
3. Corps of Engineers — Through their work with United States rivers, the Corps of Engineers have provided considerable recreational sites for boating, fishing, camping, etc.
4. Bureau of Reclamation — The Bureau of Reclamation, which is within the Department of the Interior, was established for the purpose of construction of irrigation works for the reclamation of arid lands. The Bureau of Reclamation takes pride in the amount of recreation use provided by its reservoirs. By 1976 the Bureau had constructed over 219 reservoirs with over 9,700 miles of shoreline.
5. Bureau of Land Management — The Bureau of Land Management (BLM), which is within the Department of the Interior, is the manager of the "public domain," the great federal land reserve. One-fifth of our nation's land (approximately 460 million acres) is under the jurisdiction of the BLM. A storehouse of resources for the future, these lands produce forage, fiber, forests, water, and wildlife, plus space for outdoor recreation.
6. U.S. Fish and Wildlife Service — The United States Fish and Wildlife Service in the Department of the Interior is the principal agency through which the federal government carries out its responsibilities for conserving fish and wildlife resources for the enjoyment of the people.
7. Bureau of Indian Affairs — Indian lands total some 51 million acres. This is an area slightly larger than the state of Kansas. These lands are held in trust for the Indians and are, therefore, in that sense private property. Nevertheless, a significant number of them are used by the general public for outdoor recreation.
8. Federal Highway Administration — As a road building agency for the federal government, the Federal Highway Administration administers roads on federal lands or directly handles the engineering and construction. These roads include forest highways, park roads and parkways, and access roads to national fish hatchery sites and game preserves. Highways link together, and make more accessible to the public, such places as recreational, historic, scientific, and other similar areas of scenic interest and cultural importance.
9. Bureau of Outdoor Recreation — Created in 1962, the Bureau serves as a federal focal point to assure prompt and coordinated action at all levels of government for conserving, developing, and utilizing outdoor recreational resources.

INFORMATION SHEET #9

Role of the State in Outdoor Recreation

Authority

The tenth amendment to the constitution of the United States gives the separate states authority to provide recreational services as the need for such services becomes evident.

Legislation

Legal powers are needed for the acquisition, development, and maintenance of recreational areas. Through legislation, states permit local governments authority to conduct recreational programs under the administrative arrangement considered most effective.

State Outdoor Recreation Plans

Each state is required to develop and maintain a state outdoor recreational plan. Every state has developed a plan in close cooperation with the Federal Bureau of Outdoor Recreation. Each state plan contains outdoor recreation development guidelines for selected state agencies.

To increase the availability of recreational resources, state and local governments and private interests should take actions which would:

1. Provide tax or financial incentives to encourage owners to open their areas to recreationists and limit the liability of land owners for injuries suffered on property which has been made available to the public.
2. Assure public access to existing but under-used recreational resources such as beaches, shorelines, islands, and other unique natural areas.
3. Identify flood-prone areas, surfaced mined areas, or other areas with recreational potential and take steps, where appropriate, to make them available for open space and recreational purposes.
4. Encourage the donation of land and facilities which have open space or recreational value.
5. Utilize the Land and Water Conservation Fund to acquire those lands which serve the dual purpose of providing outdoor recreational opportunities and preserving critical land resources.

Illinois State Agencies Involved with Outdoor Recreation

1. Department of Natural Resources
    - Division of Fish and Wildlife
    - Division of Forestry
    - Division of State Parks
    - Division of Reservoir Management
    - Division of Natural Preserves
    - Division of Museums and Memorials
    - Division of Outdoor Recreation
2. State Highway Department
3. State Board of Health
4. State Commission on Aging and the Aged
5. Governor's Youth Council
6. Division of Tourism

INFORMATION SHEET #10

Supply and Demand of Outdoor Recreation

Demand

The magnitude of outdoor recreation in the U.S. is great, and so is its variety. Demand for outdoor recreation can be divided into two categories:

1. Demand for particular activities — According to the Bureau of Outdoor Recreation, the most popular summertime outdoor activity is walking for pleasure. This is followed closely by swimming, driving for pleasure, outdoor games, sports, and bicycling.
2. Demand for particular resources — Outdoor recreational areas are typically categorized into three major divisions:
   a. Resource-based areas are essentially the "great outdoor" areas which are in their natural state, unchanged and unimproved. These are found in such places as forests, national parks, and the great public domain. For the most part, these areas are relatively remote from most of our nation's population.
   b. Intermediate areas, which are more accessible, are such areas as state parks and forests, fairly accessible bodies of water, and other such areas which are normally within a few hours drive from the using population. Typically, these areas have some improvements, and possess less of the natural state.
   c. User-oriented areas are those outdoor areas designed and constructed to accommodate specific forms of active participation. They include areas for swimming, picnicking, skiing, skating, and other such activities. These areas are typically readily accessible to the using public.

Factors Relating to Demand

Geographic location — Whatever the demand is for, it seems to be concentrated where the most people are. In areas that are becoming more metropolitan, outdoor pleasures that used to be taken for granted are proving harder to come by. A metropolitan population must get most of its recreation in the metropolitan region. The existence of recreational areas elsewhere is little compensation for lack of it at home.

Age — Of all the factors, age has the sharpest influence. The older people become, the less they engage in outdoor activity.

Income — In activities that demand a substantial outlay of time or money, such as boating, water-skiing, and horseback riding, it is hardly surprising that participation is higher among those who have greater incomes.

Education — Education affects participation to the same degree as income. Generally speaking, the more education a person possesses, the greater the income.

Supply

Because of various trends such as an increasing population, greater mobility, higher incomes, better education, and more leisure time, the demand for outdoor recreation is increasing. The question to be answered is how long will the supply be able to meet the increasing demand. In the United States, there is a total of 3,615,211 square miles of land and water. A good portion of this land and water has some recreational value in its present state. Must of it could be improved to have more recreational value than it presently has. Trees and grass can be grown, play fields can be laid out, and pools and lakes created. Also, fish and game can be planted and scenic areas developed. Such improvements can add greatly to the recreation potential of any area.

INFORMATION SHEET #11

Economic Impact of Outdoor Recreation

It is estimated that recreational activities account for a $50-60 billion expenditure per year of the total leisure-time market. This amount represents a little over six percent of the population income. Recreation can be used as a means of upgrading economically disadvantaged rural areas throughout the United States. The nature of the economic impact of outdoor recreation can be divided into four phases.

1. Land prices — The fact that the area has natural features which are attractive to people causes the land in that area to be under greater demand than usual.
2. Home site development — People tend to want vacation homes and recreation cabins near attractive outdoor recreation developments. It also spurs local construction activities and creates demand for construction materials.
3. Purchase of goods by visitors — People coming in large numbers to an area for recreation purchase food, gasoline, clothing, recreation equipment, and supplies. Often they stay overnight and require accommodations. It is estimated that on the average, tourists in America spend about $18 per person per day.
4. More jobs — The fact that more people visit the area means that more people are employed to provide goods and services to the visitors. Also, additional jobs are created in real estate and construction.

INFORMATION SHEET #12

Financing Recreational Areas Terms to be Defined

Tax revenues — The two most common types of tax revenues used to finance park systems come from property and income taxes.

Grants-in-aid — The granting of revenue from a higher level of government to a lower level of government has been practiced for some time for transportation, health, welfare, education, and other purposes. Recently it has become more popular for park purposes.

Gifts, bequests, trust funds — Although gifts and bequests of land are a common method of obtaining lands, it occurs very infrequently for development and operational needs.

Leases and rentals — Small amounts of income have been collected from rental of surplus property.

Bonds — Borrowing of money for capital expenditures generally is accomplished by selling bonds for cash.

Concessions — Funds derived from concessions established in parks are used to provide essential services to the public. Some examples of concession operations are stores, motels, boat and motor rentals, and stables.

Fees and charges — In the past, many outdoor recreational activities were provided free to the user. An ever-increasing demand for outdoor recreation has brought about many changes in policy. Currently there are seven recognized fees and charges appropriate for park systems.

1. Entrance fees — basic contact with large areas.
2. Admission fees — admittance to buildings or structures.
3. Rental fees — exclusive use of tangible property.
4. User fee — public use of facilities.
5. Sales revenues — merchandise, food and drink.
6. License and permit fees — authorized legal consent.
7. Special service charges — unusual service for particular purpose.

INFORMATION SHEET #13

Liability and Insurance

Operation of a recreational enterprise involves risk of liability or personal injury and for property damage. The owner or operator must realize that risks are incurred when a fee is charged to use the facilities or enter the premises. The owner should not risk operating without protection against liability claims or lawsuits. There are several preventive measures a manager can take to prevent lawsuits. They are:

1. Give special attention to making the property as safe as possible by reducing or eliminating any factor that may cause injury or loss.

2. Facilities should be equipped with appropriate safety precautions, particularly at swimming areas and shooting preserves.

3. Emergency treatment procedures should be planned and outlined, and all employees should be familiar with the plan and able to execute it.

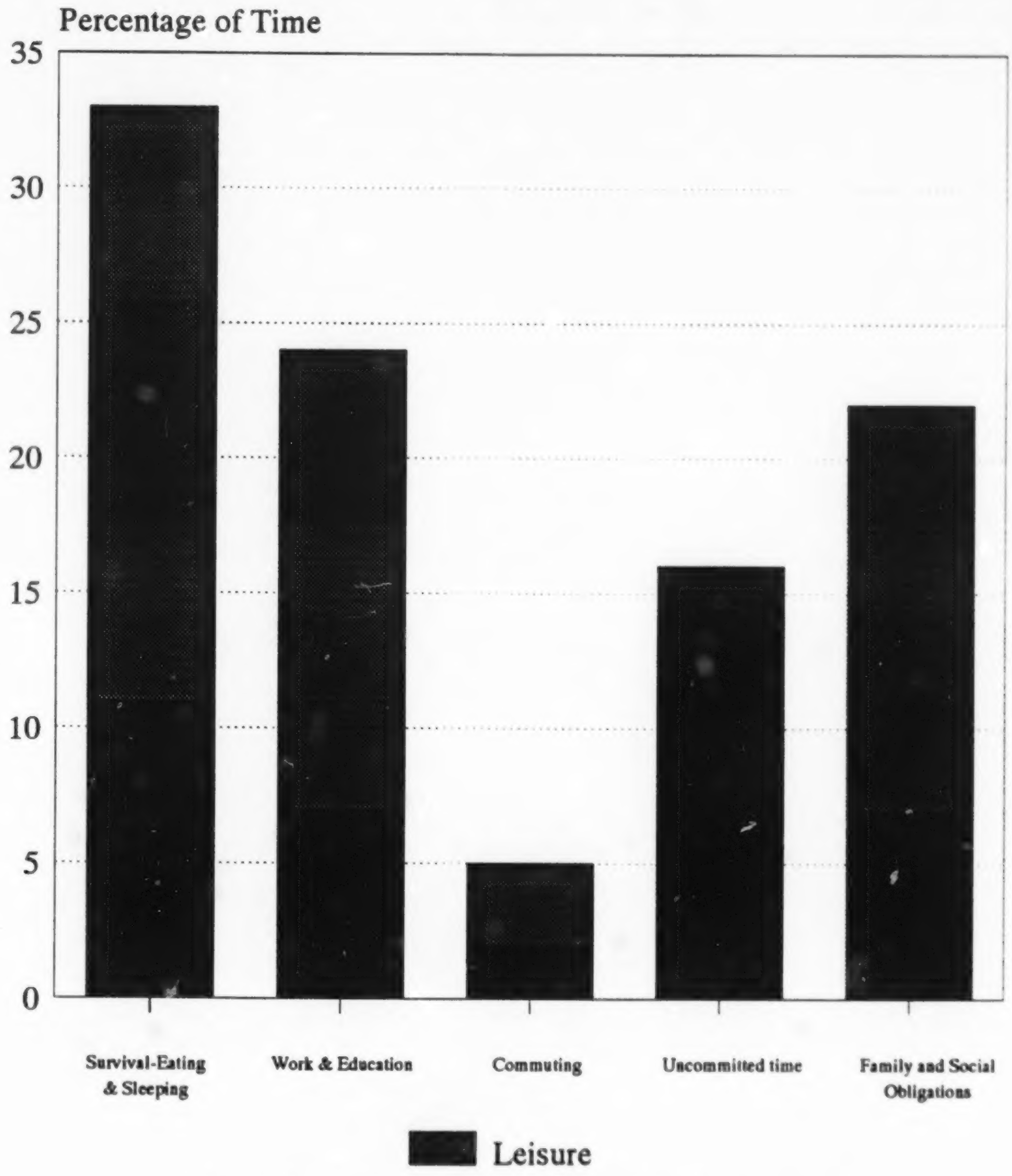
4. High-risk facilities such as diving boards, slides, and horseback riding should be given special care.

5. Regulations pertaining to the form of recreation being participated in should be posted to inform visitors as to what is permitted.

6. There should be adequate overall supervision of the enterprise.

TRANSPARENCY MASTER #1

The Diffusion of Leisure Time

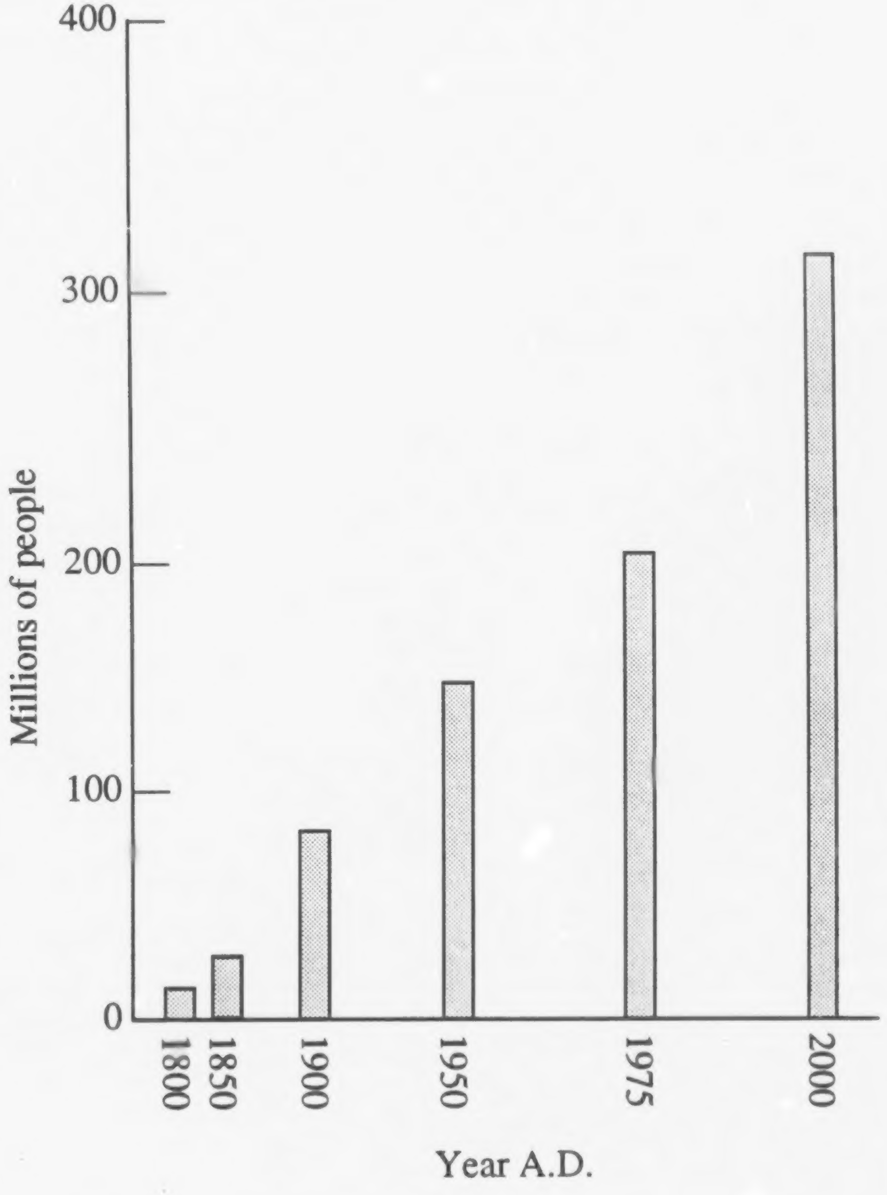


(approximate time that leisure has invaded other areas)

Source: Department of Environment, Housing, and Community Development, 1977: 1.

TRANSPARENCY MASTER #2

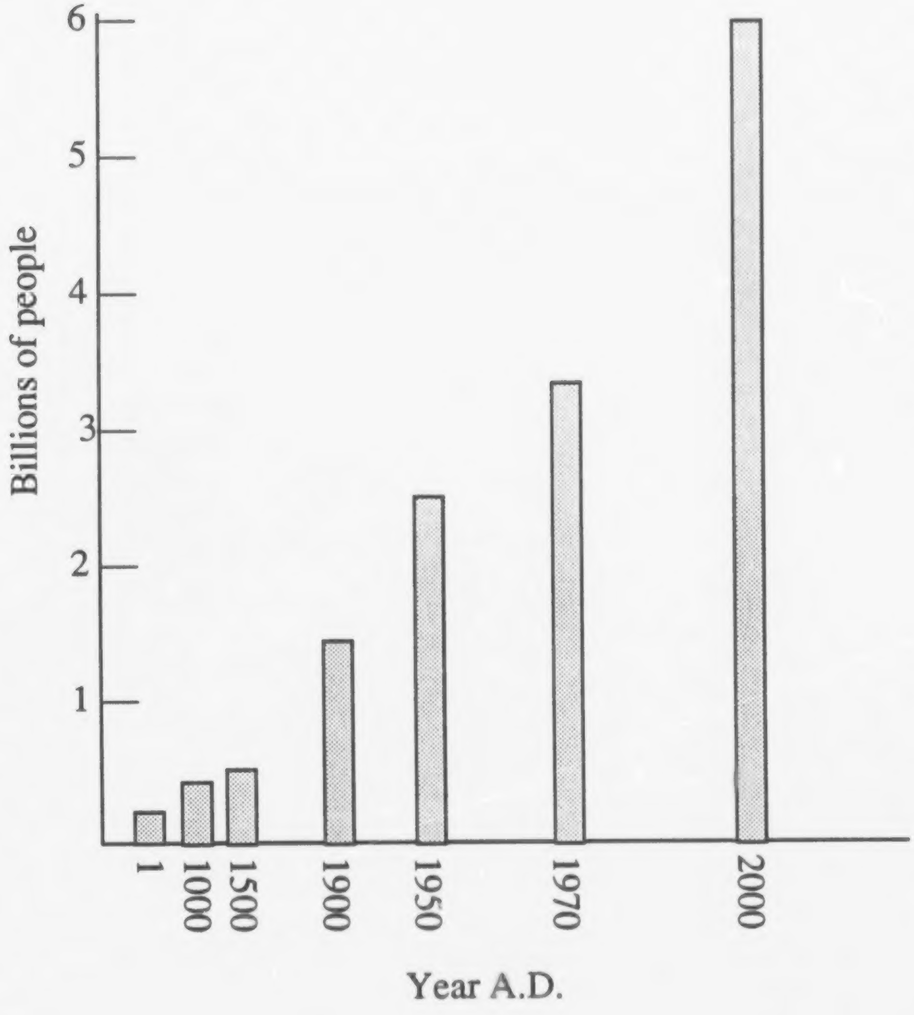
Population Growth of the United States



Population growth of the United States (U.S. Government, Bureau of Census)

TRANSPARENCY MASTER #3

World Population Growth



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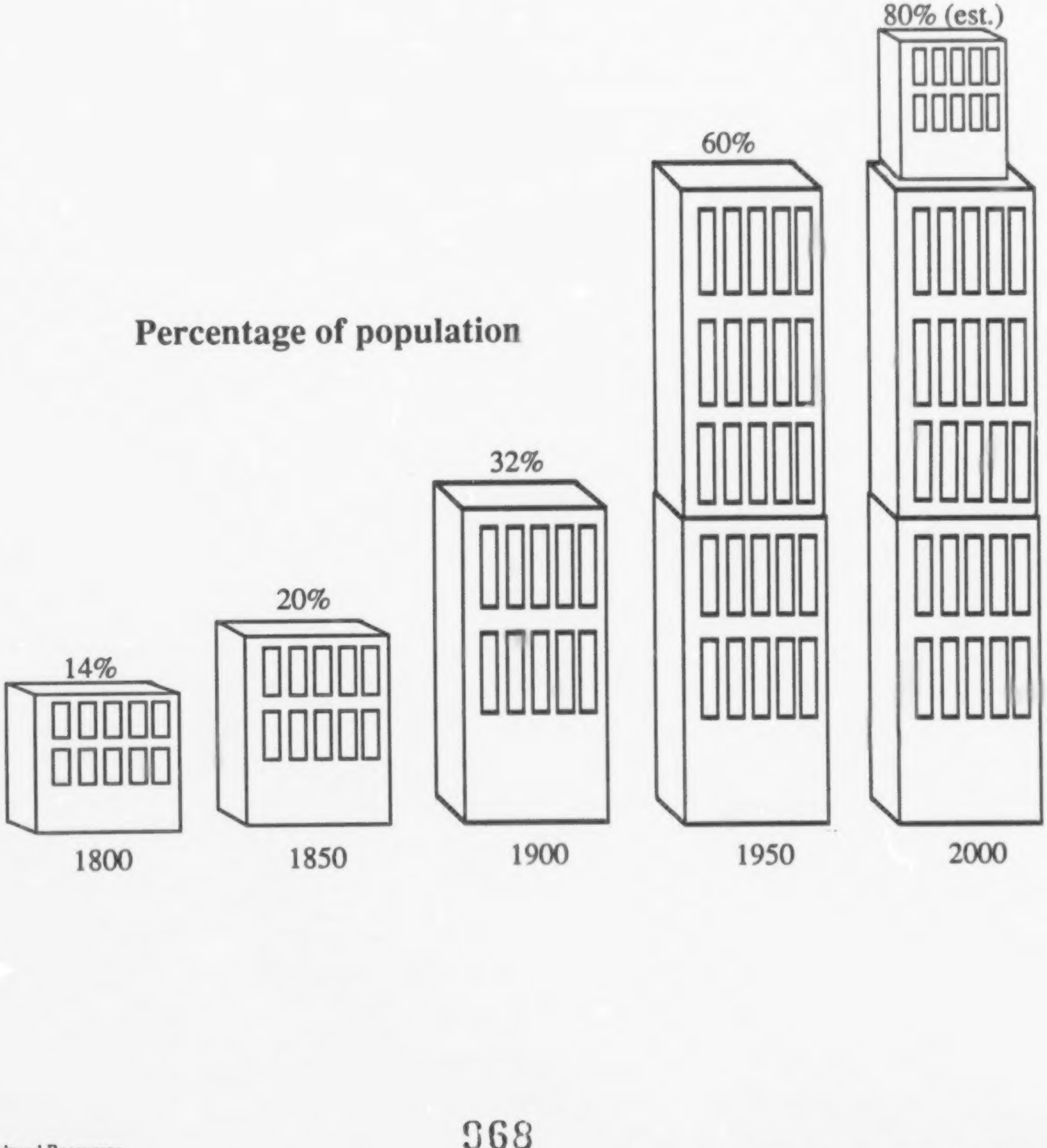
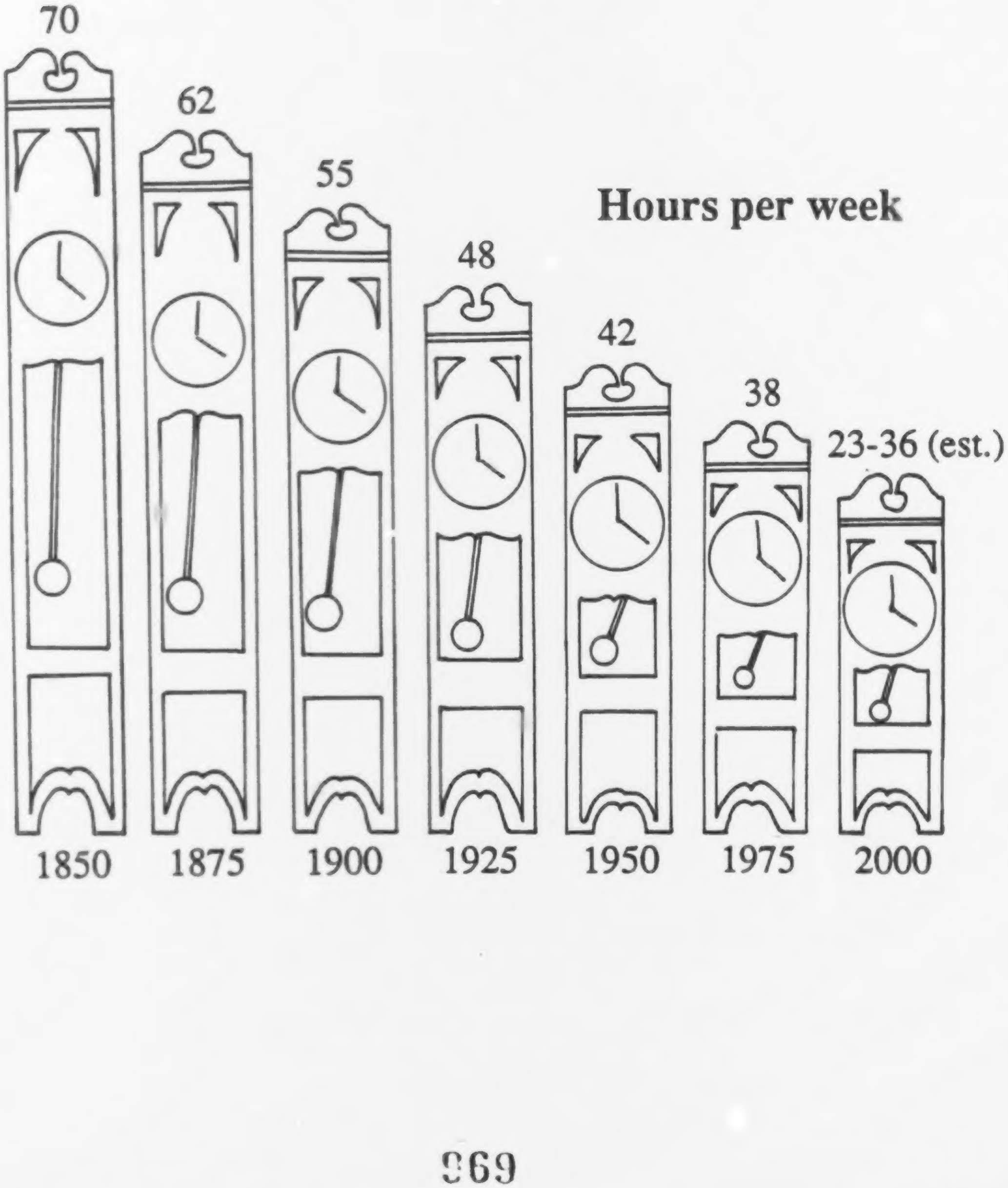
TRANSPARENCY MASTER #4

Percentage of United States Population Living in Urban Environments



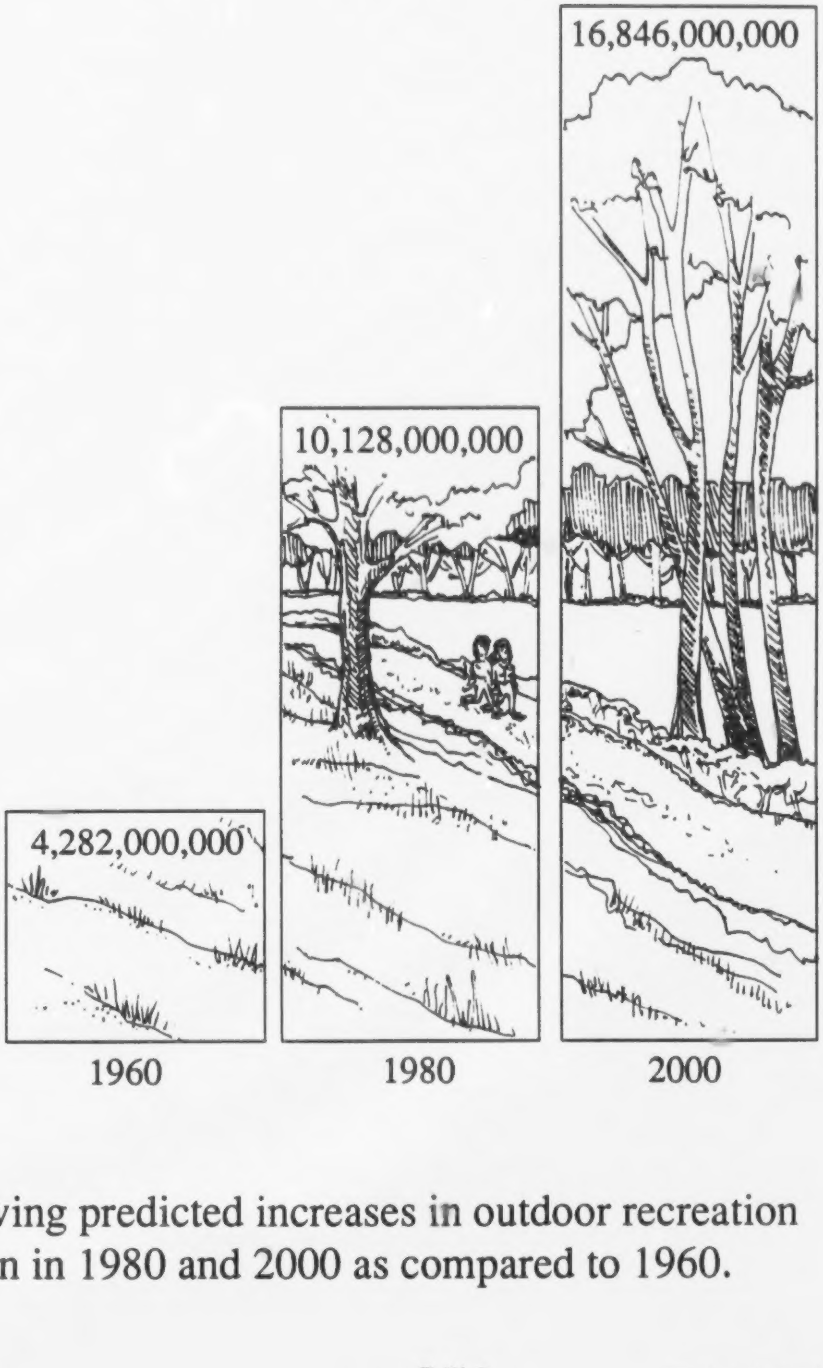
TRANSPARENCY MASTER #5

Changes in Average Work Week in America Among Nonfarm Workers



TRANSPARENCY MASTER #6

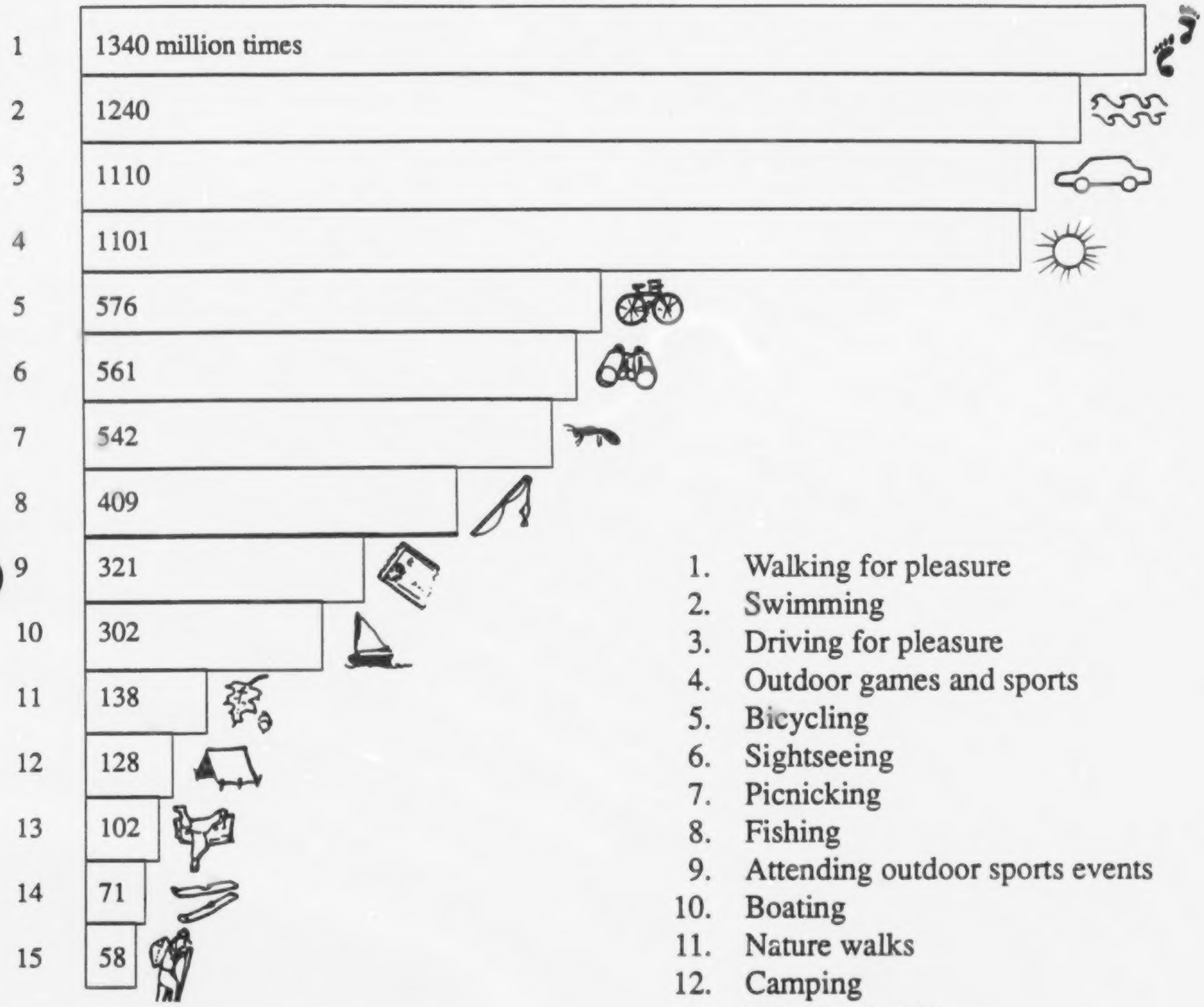
Predicted Increases in Outdoor Recreation Participants



Graph showing predicted increases in outdoor recreation participation in 1980 and 2000 as compared to 1960.

TRANSPARENCY MASTER #7

Participation in Outdoor Recreation

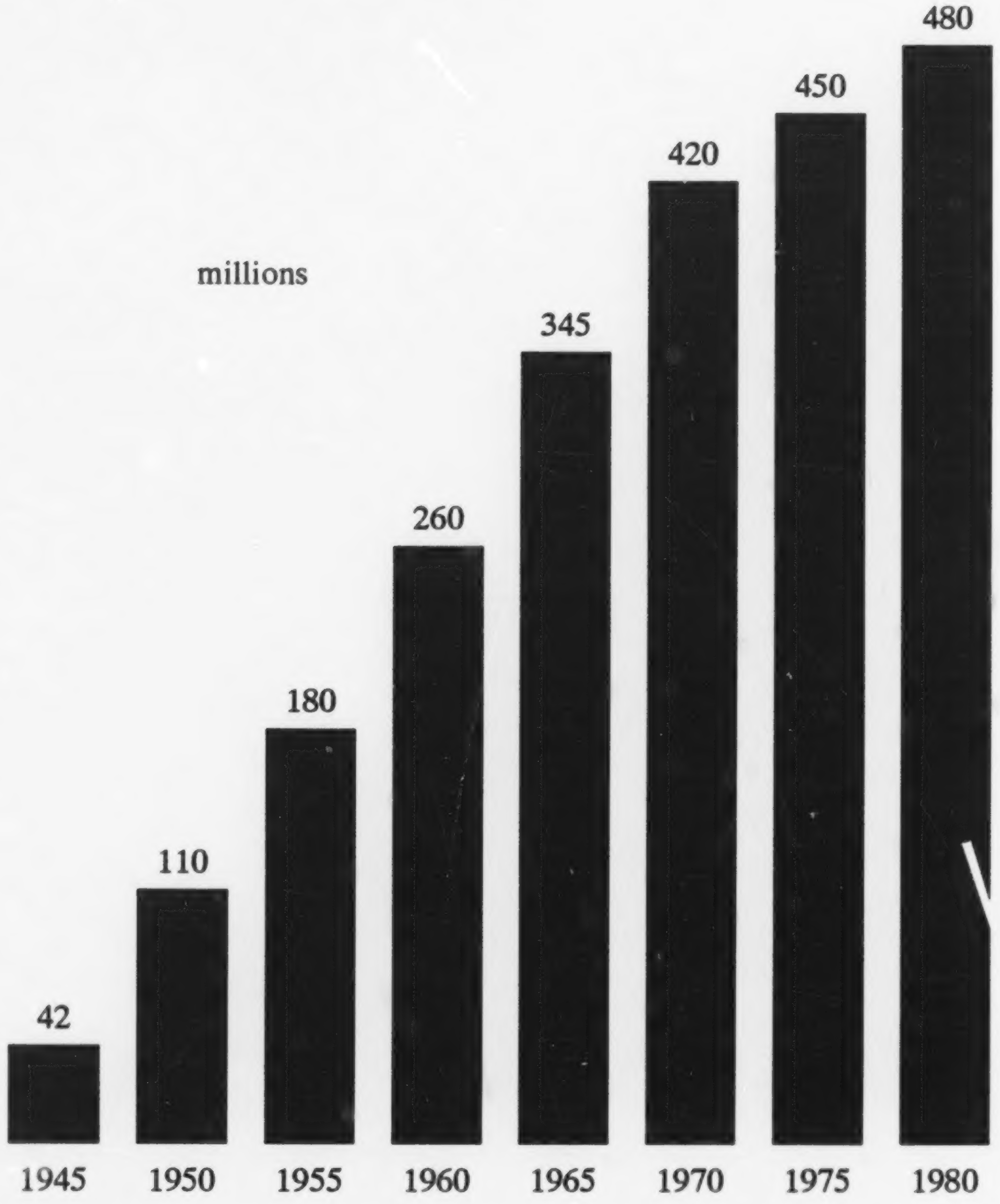


1. Walking for pleasure
2. Swimming
3. Driving for pleasure
4. Outdoor games and sports
5. Bicycling
6. Sightseeing
7. Picnicking
8. Fishing
9. Attending outdoor sports events
10. Boating
11. Nature walks
12. Camping
13. Horseback riding
14. Water skiing
15. Hiking

Graph showing number of occasions Americans participated annually in the 15 most popular summertime outdoor-recreation activities.

TRANSPARENCY MASTER #8

Visits to State Parks in the United States



Graph showing trends in number of visits to State Parks in the United States.

STUDENT ACTIVITIES

STUDENT WORKSHEET #1 — Federal Agency Program Information

STUDENT WORKSHEET #2 — Recreational Enterprise Interview

For additional activities, teachers may refer to the "Suggested Teaching Activities and Procedures" section in the Instructor's Guide.

STUDENT WORKSHEET #1

Federal Agency Program Information

1. Write one of the federal agencies listed below and ask for information about the purpose of their agency and the programs they offer.

Bureau of Reclamation
U.S. Dept. of Interior
Washington, DC 20240

National Park Service
U.S. Dept. of Interior
Washington, DC 20240

Bureau of Land Management
Office of the Director
U.S. Dept. of Interior
Washington, DC 20240

National Park Service
U.S. Dept. of Interior
Washington, DC 20240

Forest Service
U.S. Dept. of Agriculture
Washington, DC 20013

U.S. Fish and Wildlife Service
Office of the Director
U.S. Dept. of Interior
Washington, DC 20240

2. Write a summary of your findings and then discuss them in class.

STUDENT WORKSHEET #2

Recreational Enterprise Interview

Identify a recreational enterprise in your area. Interview the manager to find out about the business and then answer the following questions. Discuss the results in class.

1. What types of services and facilities are provided by the recreational enterprise?
2. How are they financed? How do they generate funds for operation?
3. What type of management is present in the operation?
4. Are they publicly or privately owned?
5. Are their fees or charges competitive with other similar enterprises?
6. What type of people use the service?
7. Do they possess unique features? What are they?
8. Is it located in a good place and easily accessible?
9. What problems have they encountered and how have they attempted to solve them?
10. What did you like most about this business? Why?
11. What did you like least about this business? Why?